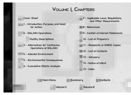

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5

Environmental Consequences

CHAPTER 5

Environmental Consequences

Chapter 5 provides information on the methods of analysis applied in the Site-Wide Environmental Impact Statement (SWEIS) and the results of analyses for Sandia National Laboratories/New Mexico (SNL/NM). The chapter begins with an introduction and a summary of the impact assessment methodologies that have been applied. It continues with descriptions of the impacts of the No Action, the Expanded Operations (the U.S. Department of Energy's [DOE's] Preferred Alternative), and the Reduced Operations Alternatives. For each alternative, impacts are presented by resource area (for example, infrastructure, land use, geology and soils) or topic area (for example, waste generation, transportation, environmental justice). Addressed later in this chapter are mitigation measures, irreversible and irretrievable commitments of resources, unavoidable adverse environmental impacts, and relationships between short-term uses of the environment and long-term productivity.

5.1 INTRODUCTION

Chapter 5 provides an analytical comparison of the environmental impacts associated with the alternatives.

> ### Types of Impacts
>
> ***Direct Impacts***
>
> These are effects that are caused by the action and occur at the same time and place. Examples of these would be the elimination of original land use due to the erection of a building or change of land use. Direct impacts may cause indirect impacts, such as ground disturbance resulting in resuspension of dust and decreasing visibility.
>
> ***Indirect Impacts***
>
> These are effects that are caused by the action or by direct impact, occur later in time or are farther removed in the distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use (such as population density or growth rate and related effects on air and water and other natural systems, including ecosystems).
>
> ***Cumulative Impacts***
>
> These are effects that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of which agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time.

Section 5.2 contains a summary discussion of the methodologies used to assess potential impacts to that aspect. Detailed methodologies, analyses, and supporting data are provided in resource-specific appendixes A through H. Section 5.3, No Action Alternative; Section 5.4, Expanded Operations Alternative (the DOE's Preferred Alternative); and Section 5.5, Reduced Operations Alternative are formatted so that, within each alternative, the discussion is divided into the following resource and topic areas:

- Land Use and Visual Resources
- Infrastructure
- Geology and Soils
- Water Resources and Hydrology
- Biological and Ecological Resources
- Cultural Resources
- Air Quality
- Human Health and Worker Safety (including Accidents)
- Transportation (including Accidents)
- Waste Generation
- Noise and Vibration
- Socioeconomics
- Environmental Justice

For comparison purposes, environmental emissions and other potential environmental effects are presented with regulatory standards or guidelines, as appropriate. However, for *National Environmental Policy Act 1969* (NEPA) purposes, compliance with regulatory standards is not necessarily an indication of the significance or severity of the environmental impact.

Several resource-specific evaluations have also been performed that address the consequences and risks associated with the DOE's operations at SNL/NM. Each evaluation has a unique scope and purpose. Figure 5.1–1 illustrates how the facility-based assessments and SWEIS-specific evaluations and consultations flow into the SNL/NM SWEIS.

This chapter also provides a discussion of mitigation measures (Section 5.6), unavoidable adverse impacts (Section 5.7), the relationship between short-term uses and long-term productivity (Section 5.8), and the irreversible or irretrievable commitment of resources (Section 5.9). A discussion of cumulative impacts is presented in Chapter 6.

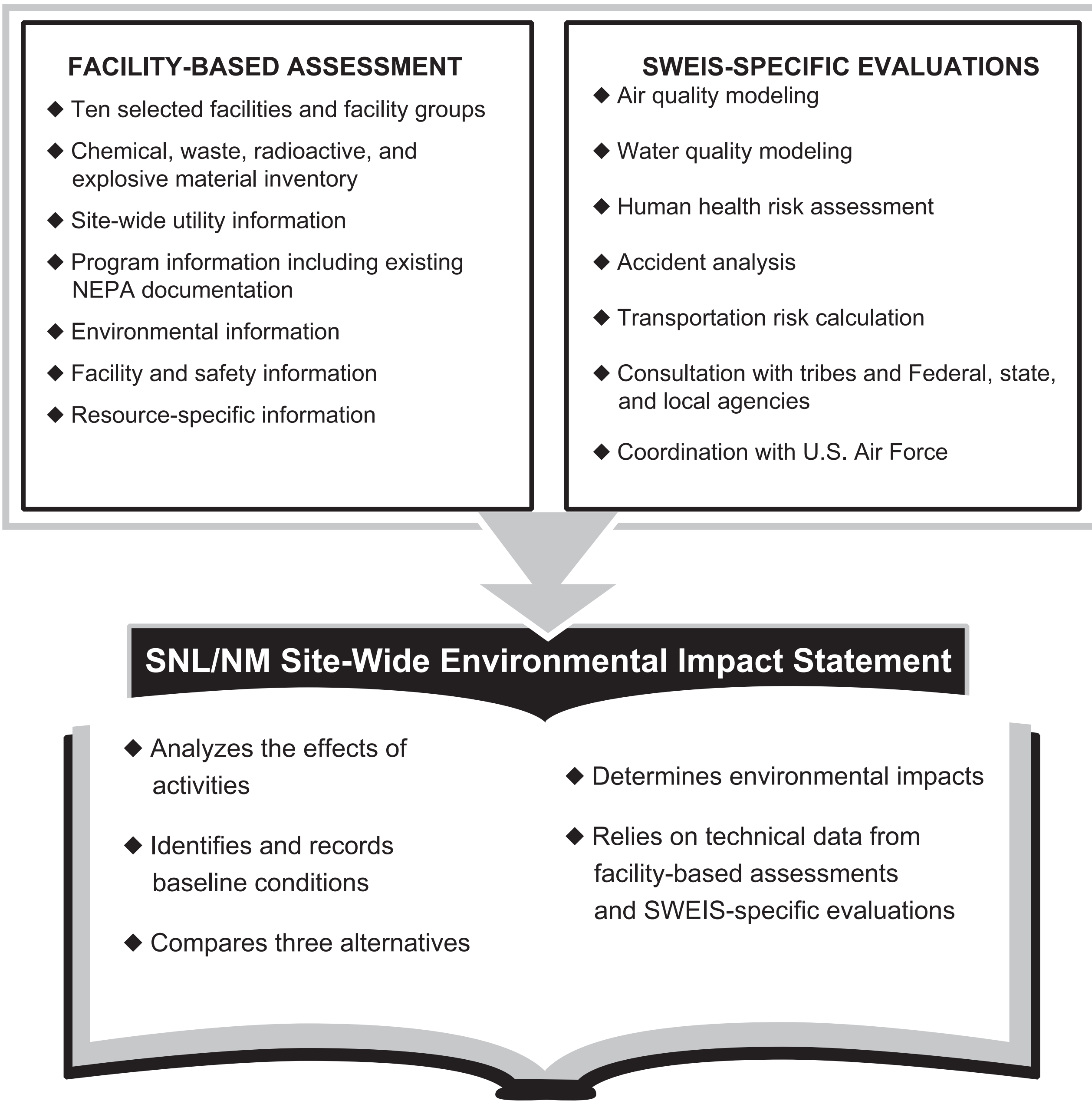

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Figure 5.1–1. Data and Analytical Contributions to the SNL/NM Site-Wide Environmental Impact Statement

The SWEIS is related to many other DOE resource-specific studies.

5.2 METHODOLOGY

Following are brief descriptions of the impact assessment approaches used in the SWEIS for addressing potential impacts of SNL/NM operations under the No Action, Expanded Operations, and Reduced Operations Alternatives. The *Sandia National Laboratories Site-Wide Environmental Impact Statement Final Methodologies for Impact Analysis* (TtNUS 1998e) provides in-depth information concerning the assessment methodologies used in the SWEIS.

5.2.1 Land Use and Visual Resources

A comparative methodology was used to determine impacts to SNL/NM land use. Facility operations and any construction or modification activities associated with each alternative were examined and compared to existing land use conditions. Impacts, if any, were identified as they relate to changes in land ownership and use classifications, extent and size figures, alternative or conflicting uses, and accessibility concerns.

The analysis of visual impacts was also comparative and consisted of a qualitative examination of potential changes in visual resources. The method of assessing a visual resource was based on the U.S. Forest Service (USFS) Scenery Management System (SMS). The SMS combines aspects of scenic attractiveness and landscape visibility to establish a series of six scenic classes. These classes indicate the degree of public value for a landscape area and serve as guidelines for future landscape changes. The higher the scenic class (on a scale where 1 is highest), the more important it is to maintain the highest scenic value. The scenic classes are 1-2, 3-4, and 5-6, corresponding to high public value, moderate public value, and low public value, respectively.

Aspects of visual modification examined included site development or modification activities that could alter the visibility of SNL/NM structures or obscure views of the surrounding landscape, changes in surrounding land cover that could make structures more or less visible, and air or light pollution associated with operations that could influence visibility factors in the area.

5.2.2 Infrastructure

Incremental changes to SNL/NM facilities and infrastructure were assessed by comparing the support requirements of the alternatives to current site infrastructure utility demands (water and electricity) based on projected facility square footage requirements and available capacities. Site-wide utility usage was adjusted for contributions from the selected facilities. Impacts were considered on a wide variety of structures and systems used by SNL/NM, including infrastructure support provided by Kirtland Air Force Base (KAFB), and assessment was focused on infrastructure, facilities, services, and utility systems. Four infrastructure facilities (steam plant, Radioactive and Mixed Waste Management Facility [RMWMF], Hazardous Waste Management Facility [HWMF], and Thermal Treatment Facility [TTF]) were specifically evaluated for impacts as representative of SNL/NM (see Section 2.3).

5.2.3 Geology and Soils

Geology and soils analyses encompassed three distinct areas: seismic, soil contamination, and slope stability. The consequences of potential seismic activity at SNL/NM are addressed within the accident analysis sections (5.3.8.2, 5.4.8.2, and 5.5.8.2) and Appendix F.

The soil contamination analysis considered the potential for human contact of near-surface (the top 6 inches to 1 ft) contaminated soils and limitations on future land use of these areas. The analysis examined the types of sites where soil contamination could be present (environmental restoration and outdoor testing areas) and site characteristics. Soil contaminant concentrations were projected under each alternative and compared with criteria for future designated land use.

The slope stability analysis examined the location of SNL/NM facilities relative to areas with potentially unstable slopes. SNL/NM facilities near these slopes were identified using a map generated from a geographic information system (GIS) showing slopes of at least 10 percent. The 10 percent value was selected as a conservative screening criterion based on the dry site soil conditions and lack of previous slope stability problems at SNL/NM. For each SNL/NM facility identified, field observations were conducted to support a qualitative evaluation of the effects of SNL/NM activities on these slopes.

5.2.4 Water Resources and Hydrology

Water resources and hydrology analyses focused on four distinct areas: groundwater quality, groundwater quantity, surface water quality, and surface water quantity.

The groundwater quality analysis determined to what extent contamination from SNL/NM sites in the unsaturated and saturated zones would limit the potential use of groundwater, particularly as drinking water. Unsaturated zone and groundwater contamination sites that have not been removed, are planned for removal, or are final or proposed no further action (NFA) sites were characterized in terms of their contaminants, concentrations, and extent. Where information was available, contaminant migration through the unsaturated zone beneath the contaminant source was characterized in terms of flow and transport parameters. A *MODFLOW/MODPATH* model maintained by the Environmental Restoration (ER) Project was used to simulate the path of contaminants from the water table beneath the source in the downgradient direction (DOE 1997a). This trajectory modeling was used with a one-dimensional (1-D)/three-dimensional (3-D) flow/transport model to determine the maximum portion of the aquifer (area and extent) that would exceed applicable water quality criteria.

The groundwater quantity analysis examined future SNL/NM water use projections, evaluating potential impacts of groundwater withdrawal. Using records of local groundwater withdrawals and water level measurements from 1985 through 1996, a simple linear relationship between withdrawal and drawdown was established. The method is described in Volume II, Appendix B.2. This linear relationship was used with projections of groundwater withdrawals from KAFB (includes SNL/NM), Ridgecrest, and Mesa del Sol wells under each alternative to estimate future aquifer drawdown. Impacts of drawdown were evaluated for existing water supply wells, springs, and land subsidence.

The surface water quality analysis examined the potential for future storm water runoff contamination in Tijeras Arroyo. Tijeras Arroyo water quality measurements at the point where the arroyo crosses the KAFB boundary were examined and compared with New Mexico Water Quality Control Commission (NMWQCC)-listed constituents and standards for designated use (general standards, livestock watering, and wildlife habitat) (NMWQCC 1994). The analysis examined changes in potential SNL/NM contributions to surface water contamination under the three alternatives and the likelihood of these changes affecting regulatory compliance at the downstream exit point of Tijeras Arroyo from KAFB.

Effects of SNL/NM facilities on surface water quantity were analyzed based on the incremental contribution of SNL/NM to Rio Grande flow from storm water runoff and wastewater discharge. The SNL/NM contribution to storm water runoff was determined by calculating the difference between estimated natural runoff (10 percent of rainfall) and an assumed 100 percent runoff from the SNL/NM area covered by buildings and parking lots. Using flow measurements from the Montessa Park gaging station in Tijeras Arroyo, a portion of total Tijeras Arroyo flow was attributed to SNL/NM, based on the percentage of watershed area covered by SNL/NM facilities. This portion was added to the projected wastewater discharge quantities (wastewater is discharged to the Rio Grande after treatment at the Southside Water Reclamation Plant) for each alternative and compared with total Rio Grande flow. Potential impacts of this additional water quantity to the Rio Grande are discussed qualitatively.

5.2.5 Biological and Ecological Resources

A qualitative analysis addresses the impacts of the activities under each alternative to biological and ecological resources. The methodology focused on those biological resources with the potential to be appreciably affected, and for which analyses assessing alternative impacts were possible. Biological resources include biological communities, biodiversity, habitat, and ecological processes. Among these resources are the vegetation, wildlife, aquatic resources, and sensitive species that are present or use SNL/NM and contiguous areas. The potential sources of impacts to biological resources that were considered include noise, outdoor tests, hydrologic changes affecting availability of water to plants and animals, erosion, hazardous materials releases and radiological releases from normal operations, and security measures that restrict access to SNL/NM.

The biological data from earlier projects, wetlands surveys, and plant and animal inventories of portions of KAFB were reviewed to identify the locations of plant and animal species and wetlands. Lists of sensitive species potentially present on KAFB were obtained from the U.S. Fish and Wildlife Service (USFWS) (USFWS 1998), the New Mexico Department of Game and Fish (NMDGF 1997), the USFS (USFS 1990), and the New Mexico Energy, Minerals, and Natural Resources Department; Forestry and Resources Conservation Division (NMEM&NRD 1995).

Activities and potential releases identified under the three alternatives were reviewed for their potential to affect plants, animals, and the sensitive species under Federal and New Mexico laws and regulations. Potential beneficial and negative impacts to plants and animals were evaluated for gain, loss, disturbance, or displacement. Impacts to wetlands were evaluated to determine if their areal extent would change. Monitoring data on selected small mammal, reptile, amphibian, bird, and plant species were reviewed for radionuclide and metal contamination (SNL/NM 1997u). Data from the ER Project were reviewed for impact to biological resources (DOE 1996c).

5.2.6 Cultural Resources

Potential impacts to cultural resources were assessed under the No Action, Expanded Operations, and Reduced Operations Alternatives. Cultural resources include prehistoric archaeological sites, historic sites, and traditional cultural properties (TCPs). Information used for impact assessment was derived from the results of systematic cultural resource inventories on KAFB, review of literature concerning TCPs and traditional uses of the area, and consultations with 15 Native American tribal governments and the New Mexico State Historic Preservation Officer (SHPO).

Data on potential SNL/NM activities occurring under the three alternatives were used to analyze impacts to resources (SNL/NM 1998a). The results of consequence analyses for hydrology, transportation, infrastructure, and land use were used to determine the potential for other impacts to cultural resources. The types of effects, or actions leading to effects, evaluated include the following:

- New construction
- Demolition
- Vibration
- Visual impact
- Radiation releases
- Hazardous material releases
- Maintenance
- Restricted access
- Explosive testing debris and shrapnel
- Hydrologic changes
- Erosion or soil movement
- Off-road vehicle traffic
- Unintended fires and fire suppression

Potential impacts to cultural resources can fall into four broad categories, called "Criteria of Effect and Adverse Effect" (36 Code of Federal Regulations [CFR] §800.9), as defined in the implementing regulations for the *National Historic Preservation Act* (NHPA), as amended (16 United States Code [U.S.C.] Section [§] 470). These categories consist of 1) destruction or alteration; 2) isolation and restriction of access; 3) introduction of visible, audible, or atmospheric elements out of character with the resource; and 4) neglect leading to deterioration and vandalism. The locations of known cultural resources were compared to the areas of potential effect from SNL/NM activities. The potential for impacts from these activities to cultural resources was then assessed.

5.2.7 Air Quality

5.2.7.1 Nonradiological Air Quality

Nonradiological air quality impacts were determined by modeling site emissions of criteria and chemical pollutants for the 1996 baseline conditions, plus those pollutant sources expected to become operational by 2008. The site-specific emissions were modeled in accordance with U.S. Environmental Protection Agency (EPA), state of New Mexico, and city of Albuquerque guidelines. The EPA-recommended *Industrial Source Complex Short-Term Model, Version 3 (ISCST3)* was selected as the most appropriate model to perform the air dispersion modeling analysis from stationary continuous emission sources. *ISCST3* and the available hourly meteorological data for 1994 through 1996 were used in the assessment of criteria pollutant air quality. The maximum concentrations of the seven criteria pollutants included in the primary and secondary National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50) and the New Mexico Ambient Air Quality Standards (NMAAQS) (20 New Mexico Administrative Code [NMAC] 2.3) were assessed, including carbon monoxide, lead, nitrogen dioxide, total suspended particulates (TSP), particulate matter smaller than 10 microns in diameter (PM_{10}), sulfur dioxide, and ozone. Ambient air monitoring data were used to supplement modeled pollutant concentrations for those pollutants for which no emission data were available.

The New Mexico Air Quality Bureau approved the Ozone Limiting Method (OLM) to estimate nitrogen dioxide concentrations in modeled nitrogen oxides emissions. The OLM was employed to estimate nitrogen dioxide concentrations in cases where the modeled nitrogen oxides concentration is greater than the NMAAQS for nitrogen dioxide. The modeled 24-hour average nitrogen oxides concentration resulting from nitrogen oxides emissions from SNL/NM exceeds the NMAAQS for nitrogen dioxide. As a result, the OLM was implemented.

Evaluation of chemical pollutant air quality consisted of modeling chemical pollutant emissions derived from the Chemical Information System (CIS), CheMaster, and

Hazardous Chemicals Purchased Inventory (HCPI) databases. The modeling was performed using the model *ISCST3*, the hourly meteorological data used for the criteria pollutant assessment, chemical purchase data, and chemical release assumptions.

Receptor locations for the criteria and chemical pollutant modeling included the maximum offsite concentration location, public access areas, hospitals, and schools. The maximum criteria pollutant concentrations at receptor locations were compared with the NAAQS and NMAAQS to determine compliance with standards, while the chemical pollutant concentrations were compared with health guidelines derived from occupational exposure limits (OEL) divided by 100 and unit cancer risk factors for 10^{-8} risk levels in lieu of established regulatory ambient air quality standards. Chemical pollutants of concern were identified through a progressive series of screening steps, each step involving fewer pollutants, which were screened by methods that involved more rigorous and realistic emission rates and modeling parameters than the step before. Chemicals that failed the screening process were referred to the Human Health risk assessment. This approach, consistent with EPA guidance, focused detailed analyses only on those chemicals of concern that have the potential to cause adverse health effects.

Analysis of the contribution of mobile sources (vehicular traffic) entering SNL/NM was performed using the *Mobile Source Emission Factor Model (MOBILE 5a)* to estimate mobile source emissions of carbon monoxide (EPA 1994). Assessment of air quality also included modeling the criteria and chemical emissions from fire testing facilities using the *Open Burn/Open Detonation Dispersion Model (OBODM)* developed by the U.S. Army and the EPA (Bjorklund et al. 1997).

Maximally Exposed Individual

The maximally exposed individual is referred to as the MEI. This is a hypothetical member of the general public assumed to be located outdoors in a public area where the radiation dose is highest. This individual is assumed to be an adult who is exposed to the entire plume in an unshielded condition. The impacts on the MEI are, therefore, greater than the impacts to any member of the public located onsite or offsite.

5.2.7.2 Radiological Air Quality

Radiological emissions from routine SNL/NM facility operations were evaluated on the basis of dose to the maximally exposed individual (MEI) and collective dose to the general population within 50 mi of SNL/NM. This evaluation was compared to the standards in the National Emissions Standards for Hazardous Air Pollutants (NESHAP) (40 CFR Part 61). NESHAP standards limit the radiation dose that a member of the public may receive from radiological material released to the atmosphere from normal operations to 10 mrem per year. The emissions from all SNL/NM facilities were reviewed. Those facilities that did not contribute more than 0.01 mrem per year (0.1 percent of the NESHAP limit) to the MEI were excluded. Ten facilities exceeding the threshold were included in the dose impact evaluation: Annular Core Research Reactor (ACRR), Defense Programs (DP) configuration; ACRR, medical isotopes production configuration; Sandia Pulsed Reactor (SPR); Hot Cell Facility (HCF); RMWMF; Mixed Waste Landfill (MWL); High-Energy Radiation Megavolt Electron Source III (HERMES III); Radiographic Integrated Test Stand (RITS); Neutron Generator Facility (NGF); and Explosive Components Facility (ECF).

The radiological impacts of normal operations were based on estimated radionuclide emission rates and were calculated using the EPA-approved *Clean Air Assessment Package (CAP88-PC)* computer model (DOE 1997e). *CAP88-PC* conservatively calculates radiological impacts extending up to 50 mi.

Two dose quantities were calculated with the *CAP88-PC* model: the effective dose equivalent from external sources and the committed effective dose equivalent from internal sources. The external dose represents exposure from airborne radiation emissions or exposure from the ground, such as standing on ground that is contaminated with radioactive material. The pathways for internal exposure include ingesting food products contaminated by airborne radiation. Although the SNL/NM site does not contain any agricultural production, agricultural data beyond the site boundary to a 50-mi radius were considered in the impact evaluation.

Potential MEIs were identified as receptor locations. These receptor locations were selected based on distance, direction, and wind speed and direction from each modeled facility. The total dose was calculated at each of the receptor locations from each of the modeled facilities. The receptor with the highest combined dose from all facilities was identified as the MEI and compared with regulatory standards. The collective dose to the population within 50 mi of SNL/NM was also determined. The methodology for assessing MEI and collective population dose impacts is further discussed in Section 5.2.8, below.

5.2.8 Human Health and Worker Safety

Normal Operations
(See Section 5.2.9 for Accidents)

An analysis of environmental conditions related to SNL/NM routine operations under each alternative and an assessment of the release of hazardous materials by way of different transport pathways were used to identify possible exposure pathways of concern to receptor locations within the SNL/NM vicinity. All environmental releases of chemicals and radionuclides with the potential to adversely impact public health or worker health and safety were evaluated for human health risk. The health risk assessment process is a series of steps associating environmental conditions with potential health effects resulting from contact with the contaminants in the environment, as illustrated in Figure 5.2.8–1.

An initial assessment identified potential sources at SNL/NM as emissions from stacks and open burning, radiological material transportation, and existing environmental contamination. Exposure pathways analyzed include inhaling affected ambient air, ingesting food products affected by radiological air releases, direct radiation exposure from radioactive air emissions and ground deposition, and direct radiation exposure from radioactive materials shipments. Human health risk calculations used exposure information derived from analysis of nonradiological air quality, radiological air quality, and transportation of hazardous material.

A receptor's exposure to a chemical contaminant was expressed in terms of chronic daily intake (CDI) or Lifetime Average Daily Dose (LADD). The numerical approach for CDI calculated potential chronic exposures averaged over a lifetime from noncarcinogenic chemicals and related them as a ratio to the EPA-derived health risk factors known as reference doses. The ratio estimates the increased risk that an individual exposed to that compound could develop an adverse health effect. The numerical approach for LADD estimated potential chronic exposures to carcinogenic chemicals and associated them with the EPA-derived health risk factor for carcinogens known as cancer slope factors (CSF). The daily intake was multiplied by the health risk CSF to estimate the increased likelihood of an individual getting cancer in his or her lifetime from that exposure.

The radiological dose assessment looked at appropriate health risk estimators for excess latent cancer fatalities (LCFs), nonfatal cancers, and excess genetic disorders. The risk estimators used are recommended by the International Commission on Radiological Protection (ICRP 1991) and are promulgated in Federal guidance. Dose to the individual was converted to the increase in lifetime risk of fatal cancer, nonfatal cancer, and genetic disorders. Population collective dose was converted to the additional number of LCFs, nonfatal cancers, and genetic disorders in the population assessed.

To account for multiple pathways, a composite cancer risk for an individual member of the public, due to both carcinogenic chemicals and radiological exposures, was derived by adding the radiological MEI cancer risk with the excess lifetime cancer risk (ELCR) due to chemical exposure. Two scenarios were developed expressing composite risk: the risk at the radiological MEI receptor location was evaluated for the contribution added by chemical exposures at the same location; and a worst-case composite risk was calculated, assuming the radiological MEI risk is hypothetically combined with the upper-bound value for cancer risk from chemicals, even though these concentrations occur at different locations.

Radiological doses to the radiation worker population were evaluated using the historic dosimetry data available for 1992 through 1996. Nonradiological impacts to workers were evaluated using occupational illness and injury data, occurrence reports, and industrial hygiene investigation reports available for the same period.

The SNL/NM illness/injury rate per year under each alternative is expected to remain consistent with the average illness/injury rate calculated for 1992 through 1996. Estimating the number of illnesses and injuries per year was based on projected changes in the total number of workers under each alternative multiplied by the "5-year average" illness/injury rate.

The same approach was used to estimate radiation workers' annual workforce collective dose. Estimating the annual workforce collective dose was based on the projected changes in the number of radiation workers under each alternative multiplied by the "5-year average" annual workforce collective dose. Annual workforce collective dose was converted to total number of fatal cancers in the radiation worker population from one year's dose.

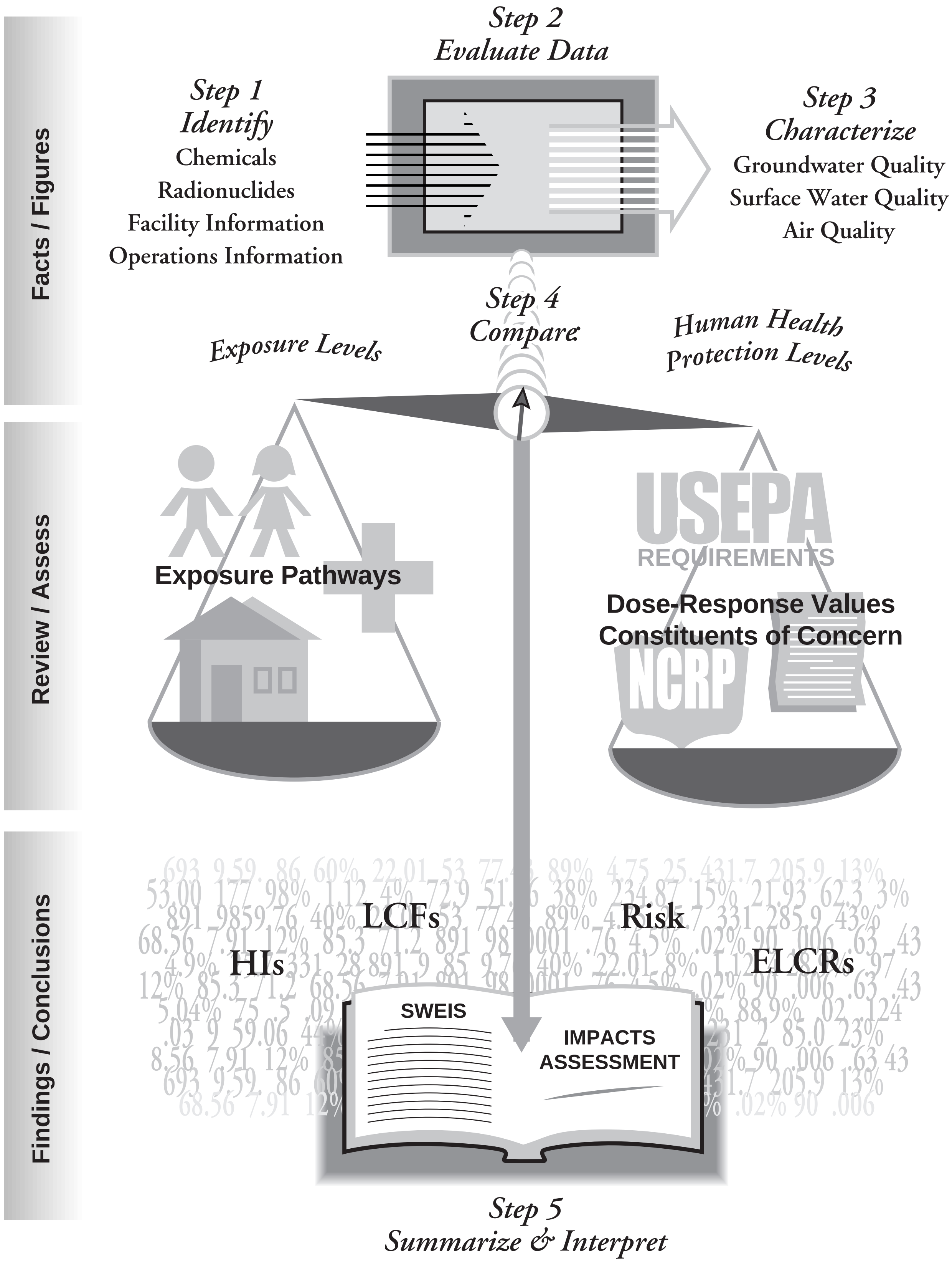

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Figure 5.2.8–1. The Health Risk Assessment Process

The health risk assessment process is a series of steps associating environmental conditions with potential health effects.

Maximum worker dose and average worker dose under each alternative are expected to be consistent with data collected in base year 1996 (see Section 4.10).

5.2.9 Accident Analysis

The requirements for accident analysis are set forth by the DOE (DOE 1993b). DOE guidance for accident analysis allows a graded approach that analyzes accidents at a level of detail that is consistent with the magnitude of the potential impacts. The Department requires that potential hazards be considered if they can lead to accidents that are reasonably foreseeable; that is, there is a mechanism for their occurrence and their probability of occurrence is generally greater than one chance in a million per year ($1x10^{-6}$). Accidents that are less frequent may also be considered if they could result in high consequences and provide information important to decision-making. Although the impacts of all potential accidents are not required, the accident analysis is required to evaluate a sample of reasonably foreseeable accidents, to demonstrate the range of potential impacts. These accidents would include both low-frequency–high-consequence and high-frequency–low-consequence events.

The accident impacts described in this section were developed as a result of detailed studies of selected SNL/NM facilities that included

- meetings with facility managers; environment, safety, and health coordinators; and/or safety personnel to identify major potential hazards and identify safety documentation applicable to the SWEIS;
- facility visits and tours to identify potential hazardous situations, gain an understanding of the mechanisms that could cause an accident, and obtain information for the development of accident scenarios; and
- reviews of facility safety documentation, including safety assessments (SAs), hazard assessment (HA) documents, process hazard surveys or studies, safety analysis reports (SARs), environmental impact statements (EISs), environmental assessments (EAs), hazardous material databases, environmental monitoring reports permits, and other source documents prepared by SNL/NM for the SWEIS.

The information and data obtained during these activities were used extensively for assessing hazards at SNL/NM facilities, developing accident scenarios, and estimating accident impacts (TtNUS 1998k).

Preliminary screenings of SNL/NM activities and operations were conducted to select facilities and operations to be evaluated. Because of the relatively large number of activities and operations at SNL/NM facilities and the large number of potential accident scenarios that could be postulated, further screening was performed to eliminate low-hazard activities and operations that would result in small consequences to receptors.

Facility SARs analyze accidents that have multiple conservative assumptions, resulting in the highest consequences. Radiological accidents generally represent accidents affecting the facility or the experiment being performed that contain radioactive materials. For accident scenarios involving stored materials, the accidents represent the maximum quantities that could be involved. Similar conservative assumptions also hold for nonradiological accidents.

The impacts to humans that could result from potential radiological accident scenarios were evaluated in terms of dose units (such as rem or person-rem), and LCFs. For chemical releases, the impacts were evaluated in terms of chemical concentrations in relation to emergency response planning guideline (ERPG) levels for specified workers and the public (AIHA 1997). The potential for accidents whose impacts are measured in units other than LCF and chemical concentrations were also addressed.

The impacts of accidents were measured in terms of the effects for six types of human receptors: 1) 14 core receptors at various onsite and offsite locations; 2) receptor locations at the KAFB boundary at the 16 compass points; 3) the MEI, who has the highest reported dose of either core receptors or boundary receptors; 4) the offsite population within 50 mi; 5) a noninvolved worker at 100 m; and 6) involved workers (generally in the immediate vicinity of the accident).

The estimated impacts of accidents can be affected by unavoidable uncertainties in the analyses. These uncertainties can be attributed to modeling techniques, source-term estimates, release fractions, health effects estimators, accident scenario definitions, meteorological data, population estimates, and similar causes. Several actions were taken to minimize the effects of uncertainties. These included the use of approved methodologies, approved and verified models, formally documented data in approved reports, conservative data estimation practices, and formal quality assurance reviews. The effects of any remaining uncertainties were further minimized when accident impacts for alternatives were compared on a relative, rather than absolute, basis.

Many of the accident scenarios excluded the effects of mitigation measures such as filtration or scrubbing of the effluent prior to release to the environment. Some chemical storage containers are equipped with internal flow restrictors that would limit the uncontrolled release of their contents. Also, emergency procedures, sheltering, and evacuation would reduce the extent of human exposures.

5.2.10 Transportation

Transportation impacts were addressed by examining onsite and offsite transportation activities involving radioactive, chemical, and explosive materials and wastes, including assessing existing transportation facilities and modes of transport. Both incident-free exposures and accident exposures to workers and the public were analyzed. Regional traffic impacts related to the alternatives were also addressed. The analysis presents a summary of the regulatory framework as it applies to transportation activities and considers current transportation procedures.

The analysis includes assessing impacts of local transportation; incident-free radiological dose to the crew and public; radiological dose (consequences) due to potential accidental release of radioactivity for a given accident (category VII); nonradiological impact due to traffic fatalities; and LCFs due to potential vehicle emissions of air pollutants from offsite transportation of materials and waste. The nonradiological traffic fatalities were calculated based on unit risk factors (fatalities per kilometer of travel for crew and public) developed from national statistics for highway accident-related deaths (SNL 1986). The radiological impacts were calculated using the *RADTRAN4* model developed at SNL/NM and documented by Neuhauser and Kanipe (SNL/NM 1992a). The LCFs due to vehicle emissions were calculated by using unit risk factors (fatalities per kilometer of urban travel) developed by SNL/NM (1982). The transportation impacts due to the movement of materials and wastes between SNL/NM and other sites would be bounding compared to the transportation impacts due to onsite transfers or movement of the materials and wastes (see Appendix G). Therefore, a detailed impact analysis was performed considering offsite transport of the materials and wastes. The details of this offsite transportation analysis are presented in Appendix G. Overall impact was evaluated in terms of total lifetime fatalities due to offsite transportation of materials and waste from SNL/NM operations.

Activity Multipliers

The activities proposed under the alternatives would potentially impact the types and quantities of material used and transported at SNL/NM. The activity scenarios from the SNL/NM Facility Information Manager were used to project inventories for facilities based on activities at the facilities. The selected existing facilities represent the types of operations that will occur at SNL/NM over the next 10 years. These activities primarily relate to test shots, production levels, and/or manpower estimates for these selected facilities. These activities have been converted to unitless numbers that have been normalized so that a site-wide aggregate multiplier for each alternative could be developed. In turn, these multipliers were used to develop projections for the waste management and transportation consequence analysis. The operations at new facilities were not considered for the multiplier because the start-up of these operations reaching their planned production levels would artificially inflate the multiplier and not truly reflect the anticipated activity levels at SNL/NM. The details of the activity multipliers are presented in Appendix A.

5.2.11 Waste Generation

The waste generation analysis examined potential impacts associated with waste generation activities of SNL/NM, including low-level waste (LLW), low-level mixed waste (LLMW), transuranic (TRU) waste, mixed transuranic (MTRU) waste, hazardous waste, and process wastewater. The ongoing waste management practices relating to generating, handling, treating, and storing wastes are described. The analysis also presents a summary of the regulatory framework as it applies to waste management and a summary of current and projected waste generation activities. Selected facilities or activities that generate waste were evaluated for changes in the baseline quantity of waste generated as a result of the proposed alternatives. SNL/NM treatment and storage facilities were evaluated for any impacts on their capabilities to manage wastes before transportation to offsite disposal. The analysis of potential impacts considered physical safety, regulatory requirements, and security measures associated with storage capacity, personnel safety, and treatment capacity.

A quantity projected under the No Action Alternative for 2003 and 2008 represents the maximum quantity projected for any given year during the 1998-2003 and 2004-2008 5-year time frames. Waste volume estimates for 2003 and 2008 are considered to be conservative and bounding based on current annual projections.

For each selected facility, a waste quantity projected under the Expanded Operations Alternative represents the maximum possible waste generation level, and thus the bounding level of operation. This applies to all waste types (including LLW, LLMW, and *Resource Conservation and Recovery Act* (RCRA) hazardous waste).

A quantity projected under the Reduced Operations Alternative represents the projected quantity of waste generated during any given year as a result of maintaining programmatic capabilities across SNL/NM at minimum operational levels based on selected facilities.

5.2.12 Noise and Vibration

The noise and vibration analysis describes the noise sources at SNL/NM by activity and location and qualitatively discusses the impacts of these noise sources. Direct and indirect impacts of the alternatives and compliance with applicable regulations are addressed. The number of noise events projected for each alternative from tests of high explosives, tests using rocket motors, tests producing sonic booms, tests involving large-caliber weapons, as well as increased noise from aircraft, vehicular traffic, and industrial sources were compared with the available baseline data. A qualitative discussion of baseline noise at SNL/NM presents examples of dBA sound levels that are typical of short-term noise impacts from SNL/NM test activities. Estimated sound levels are presented for area locations as examples of the impacts from SNL/NM test activities.

5.2.13 Socioeconomics

The socioeconomic analysis measured the incremental effects from changes in expenditures, income, and employment associated with the three alternatives at SNL/NM and their overall effect on the region of influence (ROI). The ROI, as described in Chapter 4, is the four-county central New Mexico region around SNL/NM, including the city of Albuquerque, where 97.5 percent of SNL/NM employees and their families live, spend their wages and salaries, and use their benefits.

Spending by SNL directly affects the ROI in terms of dollars of expenditures gained or lost for individuals and businesses, dollars of income gained or lost to households, and the number of jobs created or lost. Changes in expenditures by SNL (that is, dollars spent for capital goods and services in the ROI) directly affect the number of jobs created and amount of income received by individuals and businesses who provide SNL with required goods and services. In addition, by spending their income in the ROI, SNL/NM employees and their families also directly affect the number of jobs created and amount of income received by individuals and businesses in the ROI who provide them with goods and services. Changes in employment at SNL/NM directly affect the overall economic and social activities of the communities and people living in the ROI. Additionally, businesses and households in the ROI respend SNL/NM money, which creates, in turn, indirect and induced socioeconomic effects from SNL/NM operations. Every subsequent re-spending of money by businesses and households in the ROI is another tier of indirect and induced socioeconomic effects originating from SNL/NM operations.

Economic activity (expenditures), income, and employment multipliers are factors used in calculating the incremental effect of changes in socioeconomic conditions at SNL/NM. These multipliers were developed by New Mexico State University (NMSU) and are presented in *The Economic Impact of Sandia National Laboratories on Central New Mexico and the State of New Mexico, Fiscal Year 1996* (DOE 1997j). The 1997 report (update) was reviewed; however, 1996 remained the representative year for analyzing socioeconomic impacts because overall impacts remained stable.

Following are the selected socioeconomic impact areas examined:

- *Demographics*—evaluating the impact of the alternatives on the ROI's demographics;
- *Economic base*—evaluating the impact of the alternatives on the ROI economy; and
- *Housing and community services*—evaluating the impact of the alternatives on housing availability and services in the ROI

5.2.14 Environmental Justice

The potential for disproportionately high and adverse human health or environmental impacts from the proposed alternatives on minority and low-income populations was examined in accordance with Executive Order (EO) 12898, *Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 FR 7629). Both the *Environmental Justice Guidance Under the National Environmental Policy Act* (CEQ 1997) and the *Guidance* *for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses* (EPA 1998d) provide guidance for identifying minority and low-income populations and determining whether the human health and environmental effects on these populations are disproportionately high and adverse.

The environmental justice analysis presents selected demographics and identifies the locations of minority and low-income populations living in the ROI of a 50-mi radius around SNL/NM (see Section 4.15.2). For the purposes of consistency and conservative analysis, data were extracted from *Addressing Environmental Justice Under the National Environmental Policy Act at Sandia National Laboratories/New Mexico* (SNL 1997f). In this report, minority and low-income populations within the ROI were identified at the U.S. Bureau of the Census block-group level, which allows for potential localized impact analysis.

In New Mexico, the minority population in 1990 was approximately 49 percent (51 percent by 1996) of the total state population (Census 1998). In accordance with the *Environmental Justice Guidance Under the National Environmental Policy Act* (CEQ 1997), all block groups with a percent minority population greater than 49 percent were identified as being minority.

Because ROIs vary by resource area, an environmental justice impact evaluation was conducted by individual resource area. The environmental justice analysis considered impacts to minority populations and low-income populations in the ROI. Resource areas having ROIs smaller than 50 mi and not having substantial impacts were assumed to have inconsequential impacts beyond the smaller ROI. Resource areas were evaluated on an individual basis with respect to minority populations and low-income populations. Several resource areas evaluated individually water resources, cultural resources, and transportation.

Twenty-one percent of the state population in 1989 was considered to be living below the poverty level (Census 1996). Therefore, for analysis purposes, all block groups with a poverty percentage greater than 21 were identified as being low-income. Environmental justice mpacts were assessed and compared to the analysis presented for the general population by resource area for each of the alternatives. Environmental justice-related impacts are only present if the impacts to minority or low-income populations are disproportionately high and adverse in comparison to the general population.

5.3 NO ACTION ALTERNATIVE

Under the No Action Alternative, ongoing DOE and interagency programs and activities at SNL/NM would continue at currently planned levels in support of assigned missions. This would include any activities that the DOE has approved and that have existing NEPA documentation. Sections 5.3.1 through 5.3.13 describe how this alternative would affect the resource or topic areas evaluated in the SWEIS.

5.3.1 Land Use and Visual Resources

The implementation of the No Action Alternative would not affect the existing land use patterns or visual resources at SNL/NM facilities on KAFB. Sections 5.3.1.1 and 5.3.1.2 discuss these resource areas in relation to the No Action Alternative.

5.3.1.1 Land Use

The extent of DOE land and U.S. Air Force (USAF)-permitted acreage currently available for use by SNL/NM on KAFB would remain the same. Due to DOE-wide consolidation efforts and general guidance to return real estate that exceeds the Department's needs, the acquisition of additional land would be limited. One real estate transaction involving the acquisition of approximately 4 ac from the city of Albuquerque is ongoing (see Section 4.3.3.7). In general, the technical areas (TAs), which encompass over 2,800 ac of DOE property, would not change. In addition, the SNL/NM use of more than 5,900 ac on KAFB, permitted by the USAF to the DOE, would continue with periodic modifications due to the expiration of permits and the initiation of new or modified requests. The continued operation of the 10,000-ft sled track in TA-III would require continuation of leases for land adjacent to KAFB as safety buffer zones. The lease with the Pueblo of Isleta for more than 6,300 ac would remain in effect. The renewal of the lease with the state of New Mexico for more than 2,700 ac is in negotiation. SNL/NM operations would remain consistent with industrial research park uses and would have no foreseeable effects on established land use patterns or requirements. Planned SNL/NM facilities, expansions, and upgrades referred to in the *1998 Sites Comprehensive Plan* (SNL 1997a) would not require changes to current land ownership or classification status because the DOE would place such facilities in or near existing facilities, in disturbed or developed areas, or on land under DOE control.

At locations on permitted land where operations would be declining or shut down by the "owning" organization, SNL/NM would continue to hold the sites to conduct periodic safety checks and complete any ER actions (Section 5.3.3.1). Before returning land, SNL/NM would be responsible for conducting any demolition work and restoring it to its condition when originally acquired from the USAF (SNL 1997a).

5.3.1.2 Visual Resources

As stated above, the No Action Alternative would not adversely change the overall appearance of the existing landscape, obscure views, increase the visibility of SNL/NM structures, or otherwise detract from the scenic perspectives of existing and planned residential developments adjacent to KAFB. New SNL/NM facilities, expansions, and upgrades would be planned at or near existing facilities in areas with common scenic quality. Efforts initiated by SNL/NM to incorporate campus-style design are expected to continue. This style contains established principles and design guidance that provide a framework for the physical development and redevelopment of SNL/NM sites. The guidance covers building massing, facades, colors, building orientation and entries, traffic circulation corridors, standardized signage, and landscaping, including low-water-use plant selections. These efforts would be consistent with the generally high concern for scenery due to the number of observers and users in and around the area.

Limited operations at outdoor testing facilities in the Coyote Test Field and the Withdrawn Area would continue; however, no additional development is anticipated that would alter visual resources. Some testing activities would be conducted producing smoke and dust of variable quantity and duration, but these conditions would be periodic and short-term and would not change the visual characteristics of the area. Where decommissioning, demolition, or ER activities are planned, actions would be taken such as backfilling, reducing side slopes, applying topsoil, reseeding, and establishing plant growth to restore the area to its state when originally acquired by SNL/NM.

5.3.2 Infrastructure

Descriptions of important infrastructure-related services (such as maintenance), utilities (such as electricity), and facilities (such as the steam plant) are provided in the *SNL/NM Facilities and Safety Information Document* (SNL/NM 1998a), and the *SNL Sites Comprehensive Plan FY 1998-2007* (SNL 1997a). Potential incremental changes to SNL/NM services, utilities, and facilities were reviewed for each alternative. The analysis focused on incremental changes for site-wide utility demands and for the selected infrastructure facilities, the steam plant, RMWMF, HWMF, and TTF.

Regarding site-wide utility demands, most SNL/NM facilities do not meter utility use. However, annual site-wide utility demands are known and were used, in part, to make projections for this alternative (SNL/NM 1998c). These projections were made by identifying representative base years for each specific utility and calculating usage based on square footage presented in the *SNL Sites Comprehensive Plan FY 1998-2007* (SNL 1997a). These site-wide demand calculations were made independent of data collected on the selected facilities identified in Chapter 2. Site-wide utility demand estimates are presented in Chapter 3, Table 3.6–1. The assumptions used are detailed in the *SNL/NM Facilities and Safety Information Document* (SNL/NM 1998a). Any incremental changes from the base year in utility demands for the selected facilities were taken into account by adjusting site-wide demand accordingly, as presented in Table 5.3.2–1.

Analysis of four specific facilities in the selected infrastructure facility group (Section 2.3.4) was straightforward, relying on the information presented in the *SNL/NM Facilities and Safety Information Document* (SNL/NM 1998a). Projected throughput was compared to reported operational capacities as presented in Table 5.3.2–2. Air emissions from the steam plant are addressed in Section 5.3.7.1, radioactive air emissions are addressed in Section 5.3.7.2, and SNL/NM site-wide and specific facility waste generation is addressed in Section 5.3.10.

Implementation of the No Action Alternative would not affect current demands on infrastructure (described in Section 4.4). Water consumption would increase from 440 M gal per year to 463 M gal per year by 2008. However, SNL/NM has committed to a 30 percent reduction in water use by 2004. Table 5.3.2–1 shows the water use projections for the No Action Alternative and for a conservation-based scenario. The conservation-based scenario has water use decreasing from 440 M gal to 308 M gal per year before 2008. In Section 5.3.4, water use is conservatively analyzed at the 440 to 463 M gal per year projection. SNL/NM would generate approximately 280 to 304 M gal of wastewater per year. If the water use reduction effort is successful, a reduction in wastewater discharge would also occur (see Table 5.3.2–1). Annual electrical consumption would decrease from 197,000 to

Table 5.3.2–1. Annual SNL/NM Utility Usage and Capacities Under the No Action Alternative[a]

RESOURCE/ DATA SOURCE	BASE YEAR USAGE	FY 2003 USAGE	FY 2008 USAGE	SYSTEM CAPACITY[b]	USAGE[c] AS PERCENT OF CAPACITY
WATER USE					
Site-wide Demand[d]	440 M gal	430 M gal	417 M gal	2.0 B gal	21-22
Selected Facilities/ Facility Groups[e]	0 M gal	23.6 M gal	45.6 M gal	NA	
TOTAL	**440 M gal**	**454 M gal**	**463 M gal**	**2.0 B gal**	**22-23**
Conservation-Based Scenario[f]	**440 M gal**	**352 M gal**	**308 M gal**	**2.0 B gal**	**15-22**
WASTEWATER DISCHARGE					
Site-wide Demand[d]	280 M gal	273 M gal	265 M gal	850 M gal	32-33
Selected Facilities/ Facility Groups[e]	0 M gal	16.9 M gal	39.0 M gal	NA	
TOTAL	**280 M gal**	**290 M gal**	**304 M gal**	**850 M gal**	**33-36**
Conservation-Based Scenario[f]	**280 M gal**	**224 M gal**	**196 M gal**	**850 M gal**	**23-33**
ELECTRICAL USE					
Site-wide Demand[d]	197,000 MWh	192,000 MWh	186,000 MWh	1,095,000 MWh[g]	17-18
Selected Facilities/ Facility Groups[e]	0 MWh	225 MWh	225 MWh	NA	
TOTAL	**197,000 MWh**	**192,225 MWh**	**186,225 MWh**	**1,095,000 MWh[g]**	**17-18**
NATURAL GAS USE					
Site-wide Demand[d, h]	475 M ft^3	464 M ft^3	450 M ft^3	2.3 B ft^3	21-22
Selected Facilities/ Facility Groups[e, i]	0 M ft^3	0 M ft^3	0 M ft^3	NA	
TOTAL	**475 M ft^3**	**464 M ft^3**	**450 M ft^3**	**2.3 B ft^3**	**21-22**

Table 5.3.2–1. Annual SNL/NM Utility Usage and Capacities Under the No Action Alternative[a] (concluded)

RESOURCE/ DATA SOURCE	BASE YEAR USAGE	FY 2003 USAGE	FY 2008 USAGE	SYSTEM CAPACITY[b]	USAGE[c] AS PERCENT OF CAPACITY
MISCELLANEOUS					
Fuel Oil[i, j]	7,000 gal	7,000 gal	7,000 gal	Not limited by infrastructure	NA
Propane[h, i]	383,000 gal	374,000 gal	362,000 gal	Not limited by infrastructure	NA

Sources: DOE 1997k; SNL 1997a; SNL/NM 1998a, c; USAF 1998a
B: billion
ft^3: cubic feet
FY: fiscal year
gal: gallon
M: million
MW: megawatt
MWh: megawatt hour
NA: Not applicable
psi: pounds per square inch
[a] Base Year is 1996 or 1997, the most representative of usage; not necessarily the same as in Chapter 4.
[b] Capacity means the actual or calculated maximum amount of water, wastewater, or other resource that can be used, discharged, or consumed.
[c] Usage means the actual or calculated annual amount of water, waste water, or other resource used, discharged, or consumed.
[d] Prorated based on the following square footage: base year = 5.266 M; FY 2003 = 5.143 M; FY 2008 = 4.986 M
[e] Base-year site-wide demand usage was assumed to include selected facilities/facility groups; however, any changes in selected facilities' projected future usage were used to adjust site-wide demand for bounding purposes.
[f] SNL/NM expects to reduce water use by 30% based on 1996 usage of 440 M gal. Thus, between 2004 and 2008, SNL/NM water use would be 308 M gal per year. Wastewater would be similarly reduced.
[g] Based on 125-MW rating.
[h] Estimated based on 60 psi.
[i] No adjustments were reported in SNL/NM 1998a.
[j] Fuel oil is used in emergency situations at the steam plant and is not dependent upon square footage.

Table 5.3.2–2. Annual Throughput[a] and Capacities Under the No Action Alternative for the Infrastructure Facility Group

FACILITY[d]	BASE YEAR 1997	FY 2003	FY 2008	SYSTEM CAPACITY	THROUGHPUT AS PERCENT OF CAPACITY
Steam Plant (steam produced)[e]	544 M lb	544 M lb	544 M lb	3.33 B lb[b]	16
HWMF (waste handled)[e]	203,000 kg	192,000 kg	196,000 kg	579,000 kg[c]	33-35
RMWMF (waste handled)[e]	1.6 M lb	2.1 M lb	2.1 M lb	2.7 M lb	59-78
TTF (waste handled)[e]	Minimal	336 lb	336 lb	7,300 lb[b]	5

Source: SNL/NM 1998b
B: billion
ft^3: cubic feet
HWMF: Hazardous Waste Management Facility
kg: kilogram
lb: pound
M: million
RMWMF: Radioactive Mixed Waste Management Facility
TTF: Thermal Treatment Facility
FY: fiscal year
[a] Throughput means the amount of steam produced or waste handled.
[b] Permit capacity
[c] This is the capacity for single shift work with current employment level, not permit capacity.
[d] See Section 2.3 for discussion on how these facilities were selected.
[e] See Table 3.6–1, "Infrastructure" category.

186,000 MWh. Projections of annual consumption of natural gas, fuel oil, and propane are also presented in Table 5.3.2–1.

Table 5.3.2–1 shows water use and wastewater discharge increasing through fiscal year (FY) 2008, while electrical use and natural gas use decrease during the same period. This seemingly inconsistent effect is related to the fact that electricity and natural gas typically provide lighting and work environment control on a 24-hour basis regardless of activity level. This 24-hour support involves heating, steam distributing, air conditioning, and ventilating facilities, including maintaining clean room conditions and laboratory fume hoods. Thus, reducing square footage would drive a reduction in electrical and natural gas use. In contrast, water use and wastewater discharge are people-dependent and would potentially increase despite a reduction in square footage.

Projected utility consumption rates would likely fluctuate annually due to weather. The projected reduction in square footage is part of a facility strategic investment plan currently underway at SNL/NM (SNL 1997a). The minor changes in square footage are a result of removing substandard structures.

Under the No Action Alternative, current infrastructure resources are capable of accommodating SNL/NM facility requirements and no major additional infrastructure facilities are proposed to be built. Operational levels of SNL/NM buildings, services, communications, maintenance programs (including upgrades, repairs, and limited renovations), roads, material storage, and waste storage activities would remain compatible with system requirements. SNL/NM maintains an active decontamination and decommissioning (D&D) program that identifies and removes from active service outdated or substandard facilities. An overall reduction in the number of active facilities would reduce the overall impacts to SNL/NM infrastructure. Specific details on these systems and programs are presented in the *SNL Sites Comprehensive Plan FY 1998-2007* (SNL 1997a). Many of these activities are common to all alternatives and are discussed in Section 2.3.3. Additional details on land use and water resources are provided in Sections 5.3.1 and 5.3.4, respectively. Traffic-related impacts are presented in Section 5.3.9. KAFB utility usage is specifically discussed in Section 6.4.

Four specific infrastructure facilities were analyzed for impacts (Figure 5.3.2–1), including the steam plant. Steam production would continue at 544 M lb per year, which represents 16 percent of capacity. While production capacity can expand, distribution capacity has some limitations. The steam distribution system in a portion of TA-I is 40 years old and is in poor condition. In addition, the main trunk steam line is in poor condition and operates at maximum capacity (SNL 1997a). Furthermore, three of the five boilers have reached or exceeded their design life. A study to upgrade or replace the steam plant was completed in 1998. The study recommended the upgrade begin in FY 2004; however, no decision has been made to upgrade the boilers (SNL/NM 1998b).

The other three infrastructure facilities are waste management facilities (Figure 5.3.2–1). The HWMF would manage approximately 195,000 kg of waste per year by 2008 (Table 5.3.2–2). Annual radioactive and mixed waste management would increase to 2.7 M lb per year by 2008 at the RMWMF. The TTF would process small quantities of explosive wastes. Small fluctuations would occur during normal operations due to operational scheduling and shifts in priorities. ER Project wastes are discussed in Section 5.3.10 by waste category.

5.3.3 Geology and Soils

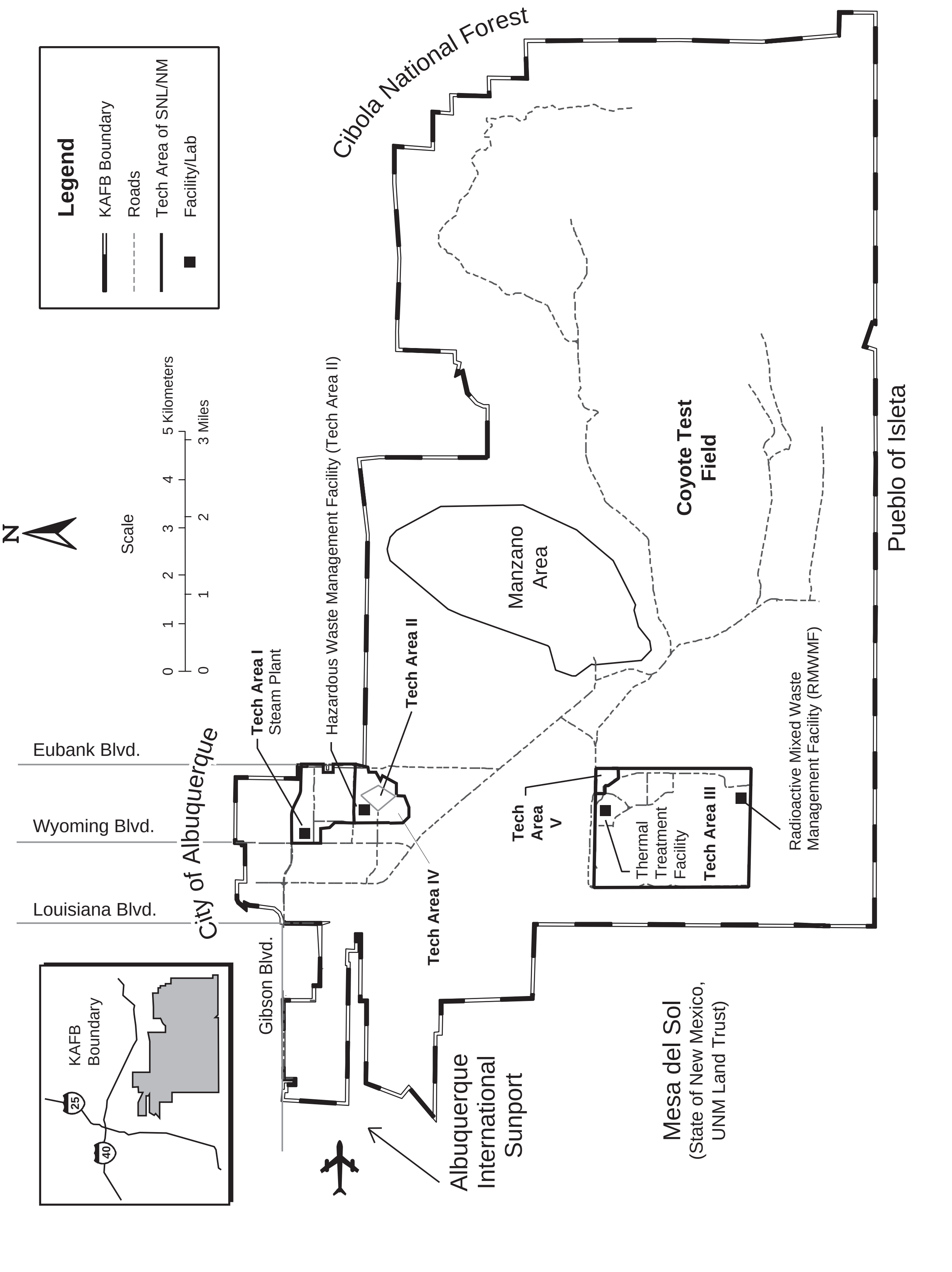
Minimal impacts due to soil contamination would be possible, as discussed in Section 5.3.3.1. A brief summary is available at the end of Section 5.3.3.1. Similarly, it would be extremely unlikely to cause impacts on slope stability, as discussed in Section 5.3.3.2.

5.3.3.1 Soil Contamination

The term soil contamination, as used in the SWEIS, is the presence of any toxic, hazardous, or radioactive substance in the near-surface soil (nominally, the upper 6 inches to 1 ft) that is not naturally occurring. Determining whether concentrations of substances, particularly metals, are contamination and not naturally occurring, is often problematic. See the text box in Section 5.3.7 "What is Background Concentration?" for a discussion on contamination and naturally occurring substances.

Near-surface soils have the potential for direct contact with humans. Onsite workers could contact these soils, although workers in contaminated areas (such as environmental restoration sites) would be subject to health and safety plans. However, analyses indicate no significant risk to the general public (DOE 1996c).

Indirect pathway effects, such as soil contamination as an intermediary to groundwater or surface water contamination, are considered in Section 5.3.4.



Source: SNL/NM 1997j

Figure 5.3.2–1. Selected Infrastructure Facilities/Facility Groups

Four selected SNL/NM infrastructure facilities/facility groups were analyzed for potential impacts.

Soil contamination at SNL/NM occurred as the result of past operations and may be occurring from ongoing operations in outdoor testing areas and radioactive material management areas. The cleanup of these soils is performed to a level that meets the health risk-based standards corresponding to the intended future uses of the site. Intended land uses are typically residential, recreational, or industrial. Soil cleanup levels are set so that the health risk to an individual using the site for its intended purpose is acceptable. Exposure levels used in the risk analysis are use-dependent. Such factors as typical time spent indoors and outdoors, amount of soil incidentally ingested, volume of air breathed while onsite, and ingestion of food grown onsite (for residential) affect the exposure and thus the residual concentrations the cleanup must meet. Remediation action levels and residual radiation site cleanup levels are based on these risk analyses.

ER Project Sites

As of August 1998, the ER Project at SNL/NM had identified 182 sites with soil contamination from past and continuing operations. Because contamination levels pose no threat to human health or the environment, the DOE has proposed no further action for 122 of 182 sites to the New Mexico Environment Department (NMED). Of these 122 sites, 48 have been approved. The remaining 74 sites are being evaluated by the NMED and may require additional characterization or some cleanup.

Inactive Sites

Of the 60 remaining sites (182 minus 122), approximately 40 are inactive sites that are undergoing further characterization or cleanup. These sites will be cleaned up to levels appropriate for future use, either as recreational or industrial sites. The Future Use, Logistics, and Support Working Group (consisting of SNL/NM, DOE, EPA, NMED, and members of the public) has agreed upon future use. Remediation of these sites was analyzed in the ER Project EA (DOE 1996c), which is described in Section 1.8.5 and incorporated by reference. All inactive sites, with the exception of subsurface contamination at the Chemical Waste Landfill (CWL), are scheduled for cleanup by 1999 (SNL 1997d). The ER Project is scheduled for completion between FY 2003 and FY 2005, depending on budget availability.

Active Sites

Of the 60 remaining sites, 20 are active. These include outdoor testing facilities, several oil spills, and storage areas. Although many of these sites may have very low levels of contamination that would normally allow them to be proposed for no further action, ongoing and potential future activities at the sites may necessitate remediation. The NMED and SNL/NM are discussing how and when characterization and cleanup activities would be completed in the future when operations cease at the active sites.

Potential soil contamination from continuing operations has been identified at four test facilities in TA-III and the Coyote Test Field: the Terminal Ballistics Complex, Sled Track Complex, Aerial Cable Facility, and the Lurance Canyon Burn Site. All of these sites are listed as active ER Project sites.

The Terminal Ballistics Complex in TA-III (ER Project Site 84) has had projectile tests conducted using lead and depleted uranium (DU) as both projectile and target materials. A total of 50 point sources and 6 small area sources were cleaned up at this site during a voluntary corrective measure of radioactive surface contamination (SNL 1997e). After the corrective measure, the maximum residual radionuclide activity at this site was 31.1 pCi of uranium-238 per g of soil (compared with an average background value of 1.4 pCi/g). A preliminary risk assessment using *Residual Radioactivity (RESRAD*), a computer modeling program, indicated that potential effects on human health due to exposure to radionuclides would be within proposed standards for the industrial land use designation developed by the Future Use, Logistics, and Support Working Group (SNL 1997e).

The Sled Track Complex in TA-III (ER Project Sites 83 and 240) has had DU, beryllium, and lead fragments released from high velocity impact tests. A total of 1,601 point sources and 33 area sources were cleaned up during a voluntary corrective measure of radioactive surface contamination (SNL 1997e). After the corrective measure, the maximum residual radionuclide activity at this site was 28.3 pCi of uranium-238 per g of soil (compared with an average background value of 1.4 pCi/g). A preliminary risk assessment using *RESRAD* indicated that potential effects on human health due to exposure to radionuclides would be within proposed standards for the industrial land use designation developed by the Future Use, Logistics, and Support Working Group (SNL 1997e).

The Aerial Cable Facility at the Coyote Test Field (ER Project Site 81) could introduce small amounts of lead, beryllium, and DU into the soil from weapons test units that could break open on impact. This has occurred twice since operations began at this site in 1971. Each time, almost all of this material was collected and properly disposed of. A radiological survey of the site indicated no elevated radiation except for naturally occurring material in rock outcrops (SNL 1997e).

The Lurance Canyon Burn Site (ER Project Site 65) has the potential for test object rupture and subsequent release of DU. Pretest and posttest sampling of the test object and surrounding area is used to confirm the integrity of the test. It is estimated that once every 10 years, less than 25 kg of DU would be released over a 1,000-ft^2 area (that is, a 35-ft-diameter circle), resulting in a soil concentration of about 7,000 µg of DU per g of soil (SNL/NM 1998a). As with all of the above sites, a release of concern such as this one would be decontaminated and cleaned up on an interim basis by trained personnel in accordance with DOE policies. The area surrounding the Lurance Canyon Burn Site, including ER Site 94, the explosive item burner within the Burn Site, was surveyed and remediated as part of a voluntary corrective measure (SNL 1997e). Fifty-four point sources and 14 area sources were cleaned up; the maximum residual activity at the site was 35.8 pCi of uranium-238 per g of soil (compared with an average background value of 2.3 pCi/g). A preliminary risk assessment using *RESRAD* indicated that potential effects on human health due to exposure to radionuclides would be within proposed standards for the recreational land use designation developed by the Future Use, Logistics, and Support Working Group (SNL 1997e).

Radioactive Material Management Areas

As of May 1998, there were 68 radioactive material management areas at SNL/NM. These are primarily indoor laboratories where radioactive materials are used in manufacturing processes or research. The Drop/Impact Complex is an outdoor radioactive material management area where sealed assemblies containing DU are tested. Impact velocities at this facility are much lower than those that would normally result in rupture and release of DU. There have been no recorded releases of DU to the environment at this facility.

Summary of Soil Contamination

In summary, known locations of soil contamination at inactive sites are planned for cleanup by 2004. Cleanup will be to levels appropriate for designated future uses. Soil contamination at active sites is monitored, and SNL/NM conducted periodic voluntary cleanups to ensure that potential human health effects are within proposed standards for the designated future land uses. The NMED and SNL/NM are discussing how and when future further characterization and cleanup activities would be completed when operations cease at the active sites.

5.3.3.2 Slope Stability

Slope stability depends on a variety of factors, including soil type, soil moisture, and load. With unloaded natural slopes that have reached a state of equilibrium over a period of years, slope failure almost invariably involves partial saturation of the sliding mass of soil by groundwater (Spangler & Handy 1973). Slope failure most commonly occurs in clay-rich soils, where platy minerals align to form a shear surface (Bromhead 1986). The arid desert climate, combined with the predominance of loamy (mixed clay, silt, sand, and organic matter) rather than clayey soils, tends to reduce the likelihood of slope failure in the SNL/NM area (SNL/NM 1997a). There are no known instances of slope failure at SNL/NM.

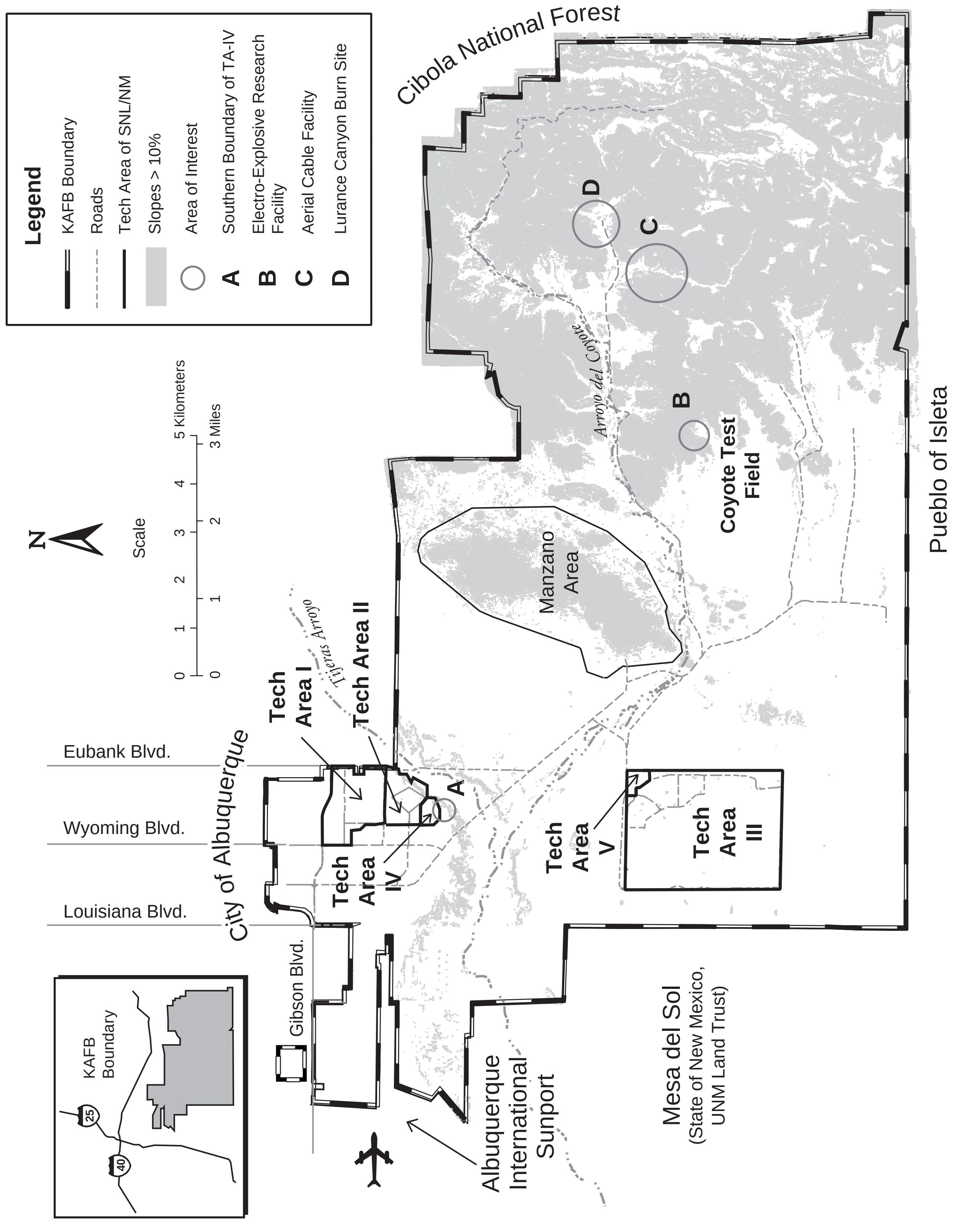
An analysis of slope stability was conducted to determine whether SNL/NM activities could cause destabilization of slopes, thereby affecting other resources, such as cultural resource sites, if such resources were present. The types of slope destabilizing activities evaluated were vibrations, surface disturbances, and burning.

A GIS-generated slope map was combined with an overlay map of SNL/NM structures to determine which SNL/NM facilities are near 10 percent or greater slopes (Figure 5.3.3–1). The 10-percent slope map simply provides a tool to identify which SNL/NM facilities are closest to slopes, so they can be evaluated on an individual basis. Ten percent is not a threshold for whether a slope is stable or unstable. The stability of slopes is heavily dependent on additional factors such as soil type, soil thickness, moisture content, and vegetation. Ten percent or greater slopes are generally confined to the Manzanita Mountains and foothills, the Manzano Area, and along the banks of arroyos.

Four areas were identified for further analysis based on Figure 5.3.3–1: the southern boundary of TA-IV, the Aerial Cable Facility, the Lurance Canyon Burn Site, and the Electro-Explosive Research Facility. These areas were evaluated using field observations of facility configuration, vegetation, evidence of erosion, and any other factors that could contribute to slope destabilization.

Southern Boundary of TA-IV

Along the southern boundary of TA-IV, five SNL/NM facilities are housed in buildings within 100 ft of a graded-



Source: SNL/NM 1997j

Figure 5.3.3–1. SNL/NM Facilities Near 10 Percent or Greater Slopes

SNL/NM facilities that are near 10 percent or greater slopes are generally confined to the Manzanita Mountains and foothills, the Manzano Area, and along the banks of arroyos.

fill slope above the main Tijeras Arroyo escarpment. (More complete descriptions of these facilities are provided in Chapter 2.)

- The SATURN and the Short-Pulse High Intensity Nanosecond X-Radiator (SPHINX) facilities are both located in Building 981. SATURN simulates the radiation effects of nuclear countermeasures on electronic and material components. SPHINX is used to measure X-ray-induced photocurrents from short pulses in integrated circuits and thermostructural response in materials.
- The Repetitive High Energy Pulsed Power (RHEPP)-I facility in Building 986 supports the development of technology for continuous operation of pulsed-power systems.
- The Z-Machine facility in Building 983 generates high intensity light-ion beams for the inertial confinement fusion program and high energy/density weapons physics program for stockpile stewardship.
- The HERMES III facility in Building 970 provides gamma-ray effects testing for component and weapons systems development, helping to ensure operational reliability of weapons systems in radiation environments caused by nuclear explosions.

The foundations of these buildings sit in natural ground (gravelly, fine, sandy loams of the Embudo and Tijeras Series [SNL/NM 1997a]), although a graded-fill slope of about 30 percent exists along the periphery of TA-IV leading into Tijeras Arroyo (Winowich 1998). This graded-fill slope is approximately 30 ft high and has light vegetation (primarily grass) cover. Minor erosional channels from storm water runoff are visible along the slope surface, but these are less than 6 inches wide or deep. The areas around the buildings and extending to the edge of the slope are paved, eliminating destabilization from significant water infiltration. At the base of the graded-fill slope, a gentler, natural slope (less than 10 percent) leads toward the main channel of Tijeras Arroyo, approximately 500 ft to the south and southeast. The base of the graded-fill slope is 20 ft higher than the current Tijeras Arroyo channel; there is no evidence of erosion at this point from water running through Tijeras Arroyo. The facilities are not in a floodplain.

Under the No Action Alternative, no new activities would be conducted in this portion of TA-IV. Based on the low potential for water infiltration, the lack of slope-destabilizing activities identified at these facilities (SNL/NM 1998a), and SNL/NM experience to date, the likelihood of slope failure at this location is remote.

Aerial Cable Facility

The Aerial Cable Facility provides a controlled environment for high velocity impact testing on hard surfaces and precision testing of full-scale ground-to-air missiles, air-to-ground ordnance, and nuclear material shipping containers for certification. (A more complete description of this facility is provided in Chapter 2.) The slopes surrounding the Aerial Cable Facility exhibit numerous bedrock outcrops. No soil classification has been assigned to this area (SNL/NM 1997a), because only a thin veneer of soil overlies the bedrock. Medium to heavy juniper-dominated vegetation is present in areas with this thin soil cover. Activities at the Aerial Cable Facility can result in hot missile debris causing brush fires in the downrange impact area (SNL/NM 1998a). Evidence of one such burn (approximately 1 ac) was noted during the May 1998 reconnaissance. (Section 5.3.8 discusses other impacts associated with accidental burns.) However, there is no evidence of landslides or recent erosion in the burn area or other areas surrounding the facility.

Under the No Action Alternative, more tests would be conducted at the Aerial Cable Facility, with some types of tests doubling from their 1996 base-year frequency. However, based on the predominance of bedrock slopes and lack of evidence of slope instability (even in the burned area), the likelihood of slope failure at this location is remote.

Lurance Canyon Burn Site

Safety tests of various hazardous material shipping containers, weapon components, and weapon mockups in jet propulsion (JP)-8 aviation fuel fires, propellant fires, and wood fires are conducted at the Lurance Canyon Burn Site. (A more complete description of this facility is provided in Chapter 2.) The site is located in a canyon at the junction of two arroyos in the Manzanita Mountains. The facility sits on relatively level ground in the canyon bottom. Surrounding slopes have numerous bedrock outcrops. No soil classification has been assigned to this area (SNL/NM 1997a), as only a thin veneer of soil overlies the bedrock. Medium to heavy juniper-dominated vegetation is found in areas with soil cover. Adjacent arroyo channels are graded or have escarpments less than 3 ft high. The facility is graded with minor slopes and little vegetation. There is no visible evidence of landslides or erosion.

Under the No Action Alternative, testing at the Lurance Canyon Burn Site would continue at 1996 base-year levels. Based on the predominance of bedrock slopes and lack of evidence of slope instability, and because no slope-destabilizing activities have been identified at this facility (SNL/NM 1998a), the likelihood of slope failure at this location is remote.

Electro-Explosive Research Facility

The Electro-Explosive Research Facility has been used for the past five years for developing electromagnetic launch technology. The main building (Building 9990) is a concrete structure now used as a control, instrumentation, and shop facility. Two metal buildings house electromagnetic launchers and propulsion experiments. Although the main building was originally constructed for explosives testing, explosives are no longer stored or used at the site. Projectiles are launched at high velocity by magnetic fields, not propellants, a distance of 600 to 800 yards eastward to the adjacent hillside for projectile diagnostics, study of exterior ballistics, and technology demonstration (SNL/NM 1994a).

The main building and bunkers of this facility are located in a canyon in foothills of the Manzanita Mountains. The main building abuts a hill. Surrounding slopes are covered with grass and minor juniper vegetation. Bedrock outcrops indicate that the soil cover is thin, although soils in this area are assigned to the Salas Series (typically very gravelly loam and stony soils). There is no visible evidence of landslides or erosion. Based on the predominance of bedrock slopes and lack of evidence of slope instability, the likelihood of slope failure at this location is remote.

Summary of Soil Stability

In summary, the four areas identified for further analysis were unlikely to pose a slope failure problem.

5.3.4 Water Resources and Hydrology

5.3.4.1 Groundwater Quality

Sites with potential or known groundwater contamination at SNL/NM are Sandia North (an ER Project designation for groundwater investigations of sites in TA-I and TA-II), the Mixed Waste Landfill (MWL), locations in TA-V, the Lurance Canyon Burn Site, and the CWL (SNL 1997d) (Figure 5.3.4–1). Information on the types and concentrations of potential contamination at these sites is presented in Section 4.6.1. Measurements (see Appendix B, Tables B.1–1 and B.1–2) indicate that some contaminants at some of these sites exceed the maximum contaminant levels (MCLs) contained in federal drinking water standards (40 CFR Part 141). MCLs are the levels of contaminants allowed in public drinking water systems, which are set by the EPA to provide protection from adverse health effects. MCLs are used in this analysis only as a frame of reference for evaluating groundwater quality. Existing institutional controls prevent access to this groundwater. Investigation or remediation of these sites is ongoing as part of the ER Project.

Sandia North

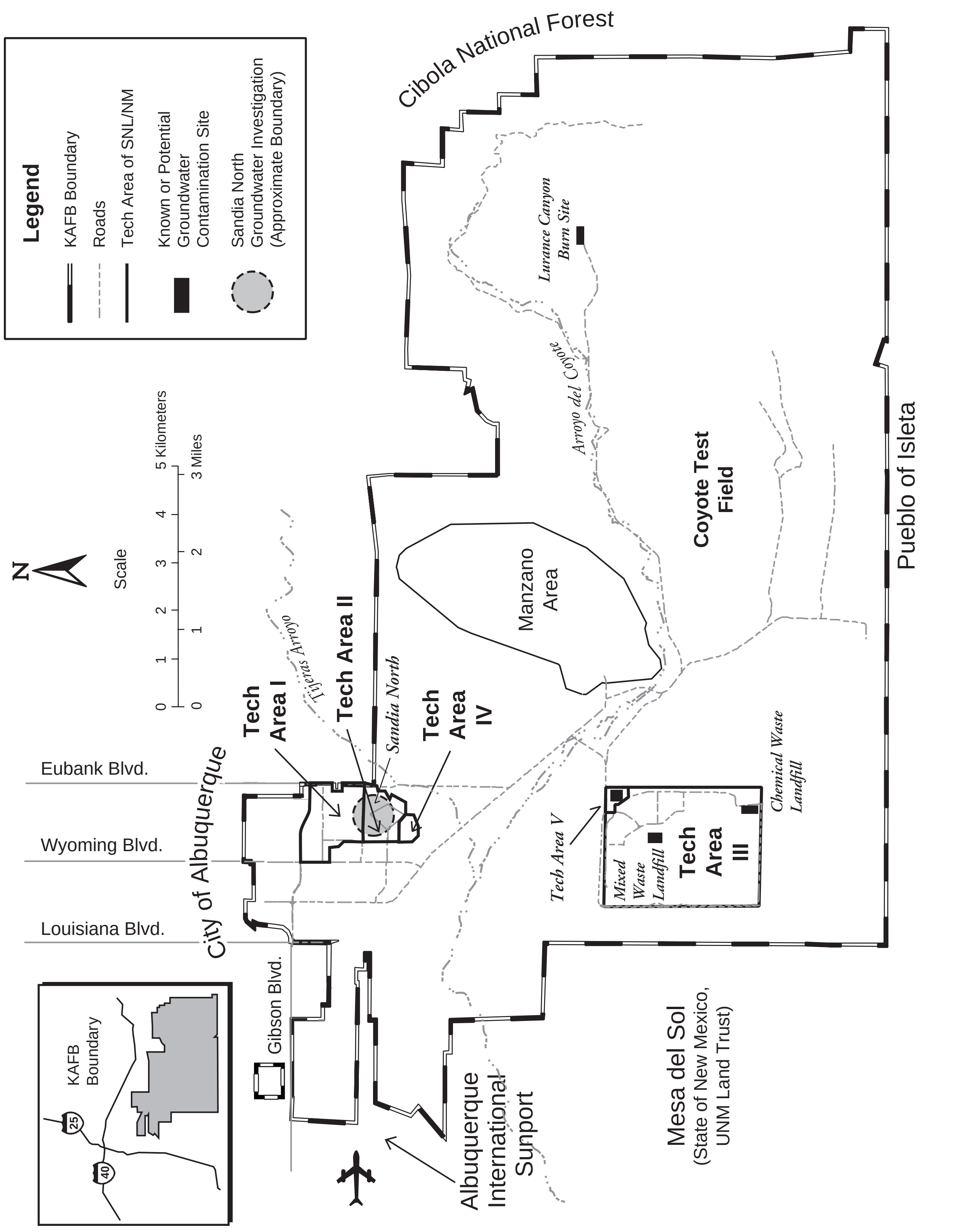
Current uncertainty regarding the nature of contamination sources and local hydrogeology at Sandia North precludes projections of future impacts at this time. As information is developed, SNL/NM will be projecting impacts and formulating mitigating measures to prevent such impacts. These formulations and, ultimately, site remediation actions will be performed under SNL/NM's ER Project and will be overseen by the NMED.

Mixed Waste Landfill

Tritium has been found in soil moisture to a depth of 120 ft below the MWL. The maximum tritium activity at this depth was 2.9 pCi/g, which, for 4.6 percent volumetric moisture content and a soil density of 1.8 g/cm^3 (SNL/NM 1996h), corresponds to a soil moisture concentration of 1.135x10^5 pCi/L. Assuming the tritium that has migrated the farthest is from the earliest release (1959), and using a linear time-distance relationship, this tritium will not reach the water table for 105 years from the time of the above measurement (1995). With a half-life of 12.3 years, the resulting tritium concentration in this soil moisture, when it reaches the aquifer (prior to dilution by aquifer water), would be 310 pCi/L, which is a factor of about 60 less than the MCL of 20,000 pCi/L. A similar calculation for the maximum measured soil concentration of 20,670 pCi/g, found at a depth of 26 ft, results in an estimated concentration upon reaching the aquifer (prior to dilution by aquifer water) of about 4,000 pCi/L, a factor of 5 less than the MCL. SNL/NM has removed broken and subsided concrete caps at the MWL to reduce the possibility of infiltration of precipitation into underlying wastes. The waste pits where the concrete caps were removed were backfilled with soil to ground surface. Site remediation is budgeted and planned to be completed in 2001.

TA-V

The likely sources of the nitrate and trichloroethene (TCE) contamination shown in Table 4.6–1 at TA-V are septic tanks and leachfields. These septic tanks and leach



Source: SNL 1997d, SNL/NM 1997j

Figure 5.3.4–1. Sites with Potential or Known Groundwater Contamination

Sites with potential or known groundwater contamination are located at TAs-I, -II, -III, and -V and the Lurance Canyon Burn Site.

fields have been closed and waste and contamination from these sites have been removed. Disposal is now to the sanitary sewer.

TCE contamination in TA-V groundwater is unlikely to pose a threat to human health or the environment, based on analytical modeling conducted for the *Summary Report of Groundwater Investigations at Technical Area V, Operable Units 1306 and 1307* (SNL/NM 1999c). This modeling assumed the nearest potential downgradient receptor was a hypothetical residence located near the proposed Mesa del Sol subdivision, approximately 9,000 ft west of TA-V, at the KAFB boundary. Results indicated that no contaminant concentrations at this receptor would exceed the remedial action standards or even 10 percent of the preliminary remediation goals. Therefore, the DOE believes there is minimal potential for risk to future residents at the KAFB boundary and minimal impact to human health.

Lurance Canyon Burn Site

Elevated nitrate and low levels (below MCLs) of toluene, ethylbenzene, and xylenes are present in groundwater beneath the Lurance Canyon Burn Site (SNL/NM 1998hh). Toluene, ethylbenzene, and xylenes are components of fuel oil, and appear to be related to operations at the Lurance Canyon Burn Site. The source of contamination is being investigated.

Groundwater in this vicinity is found beneath a layer of alluvium, in fractured bedrock, under semiconfined to confined conditions. Contaminants could be transported downgradient within the fractured bedrock; however, the regional aquifer is 7 mi away. There is no impact to existing potable water supplies beyond the immediate area of the Burn Site.

Chemical Waste Landfill

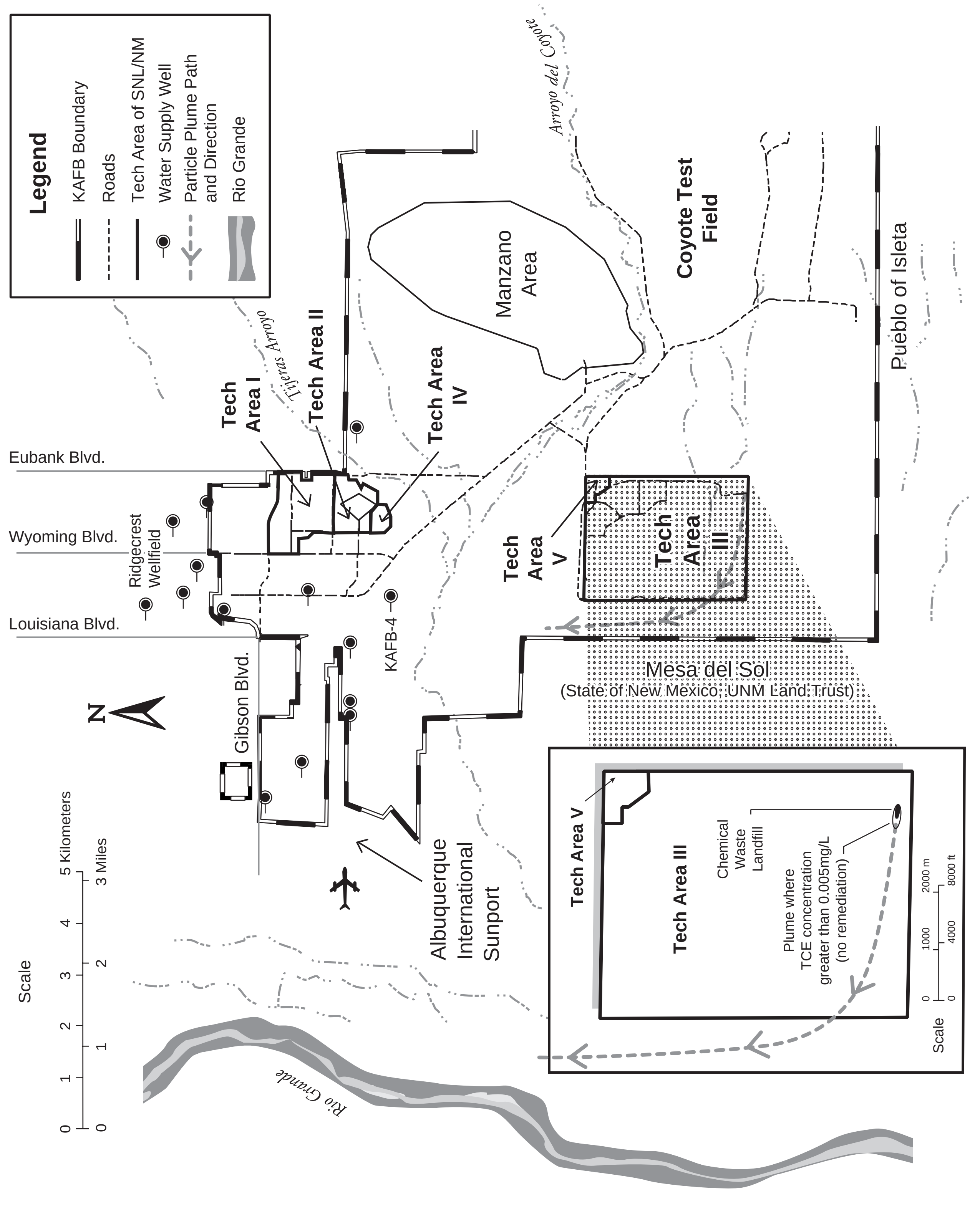
A study was performed for the SWEIS to consider the ultimate fate of the primary CWL contaminants (see Appendix B, Tables B.1–1 and B.1–2). The study used the *Multimedia Environmental Pollutant Assessment System (MEPAS)* model (PNL 1989), described in Appendix B, to estimate the downgradient concentrations of chromium and TCE in the aquifer.

The site conditions used in the modeling are described in detail in Appendix B. The source and unsaturated zone parameters represent the site directly beneath the CWL, in the region of vertical contaminant transport. The saturated zone parameters represent the site along the projected groundwater flow path, from the CWL to the nearby municipal well field (Ridgecrest), located approximately 7 mi north of the CWL (DOE 1997a). The nearest downgradient drinking water supply well, KAFB-4, located approximately 4 mi north of the landfill, also lies along this flow path (Figure 5.3.4–2) (SNL/NM 1995d).

TCE presently in the groundwater is attributed to vapor phase transport of TCE volatilizing in the unsaturated zone (SNL/NM 1995d). Appendix B contains a discussion on the derivation of the vapor source term, which was calculated as 33 g per year into the uppermost saturated layer. This uppermost saturated layer is a silty clay layer, approximately 40 ft thick, through which the downward (vertical) movement occurs at a pore velocity of 0.03 ft per year and horizontal movement occurs at a pore velocity of 0.07 ft per year. Horizontal movement toward the drinking water wells would be predominantly through the underlying sandy aquifer. Appendix B describes the model's assumptions, inputs, and results.

The model results indicate that the maximum concentrations in the sandy aquifer (through which the potential contaminants would be transported from the landfill and from which the drinking water wells draw their water) would be an order of magnitude less than drinking water standards. The maximum downgradient distance from the source within which the 0.005 mg/L MCL would be exceeded is 410 ft, corresponding to an aquifer area of 1.7 ac (Figure 5.3.4–2). After remediation, planned for completion by 2001, downgradient concentrations would be expected to decline quickly. The maximum downgradient distance within which the MCL would be exceeded would decrease to 190 ft after 50 percent remediation, to 3 ft after 90 percent remediation (the remediation efficiency objective), and would not exceed the MCL for a remediation efficiency of 95 percent. Concentrations in the silty clay layer immediately below the TCE source would continue to exceed the MCL, at a level up to 0.05 mg/L, decreasing in response to source remediation. Table 5.3.4–1 summarizes the model results. The MCL concentration at its farthest downgradient extent will be reached approximately 5 years after introduction into the sandy layer and will begin to decrease approximately 10 years thereafter as a result of source remediation.

The aquifer is presently not being affected from unsaturated zone transport of liquid organic phase TCE. Measurements have recently been taken that indicate degradation of this TCE to smaller chlorinated



Sources: SNL/NM 1997a, j

Figure 5.3.4–2. Projected Extent of Chemical Waste Landfill Trichloroethene Contamination Above Maximum Contaminant Level

The maximum calculated extent of TCE contamination above 0.005 mg/L is 410 ft from the CWL.

Table 5.3.4–1. Estimated Concentrations of Vapor-Phase Trichloroethene and Chromium in the Aquifer Beneath the Chemical Waste Landfill

CONTAMINANT	AMOUNT OF CONTAMINANT AVAILABLE FOR MOVEMENT (kg)	DRINKING WATER STANDARD (mg/L)	TIME OF MAXIMUM DOWNGRADIENT STANDARD EXCEEDANCE (YEARS FROM REACHING AQUIFER)	MAXIMUM DISTANCE FROM SOURCE AT WHICH STANDARD IS EXCEEDED (ft)[a]	MAXIMUM AREA OVER WHICH STANDARD IS EXCEEDED (ac)[a]
Trichloroethene Prior to Remediation	31,000	0.005	5[b]	410	1.7
Chromium[a, c]	9	0.100	-	0	0

Source: 40 CFR Part 141
ac: acres
ft: feet
kg: kilograms
MCL: maximum contaminant level
mg/L: milligrams per liter
[a] Assumes no remediation
[b] Reduced below MCL at this distance due to remediation 5 years from first exceedance
[c] Not projected to reach water table
Note: See Appendix B for details regarding calculations

compounds including dichloroethane (Ardito 1998), which would result in undetectable concentrations of TCE in the water table (Appendix B).

Chromium was disposed of in the form of chromic acid, and presently resides totally in the unsaturated zone, to a depth of up to 75 ft below ground level. Although not presently affecting the saturated zone, this chromium may reach the saturated zone in the future. The EPA has conducted studies that show that hexavalent chromium is frequently reduced to trivalent chromium in the environment (Palmer & Puls 1994). Trivalent chromium has relatively low toxicity and very low mobility. The EPA has also indicated that hexavalent chromium can be expected to adsorb to soil, although not as strongly as trivalent chromium (EPA 1996b). This SWEIS conservatively assumes that the chromium would remain in its original hexavalent state and would not undergo soil adsorption (SNL/NM 1995d). Appendix B contains a description of the parameters used to conduct the analysis. The highest levels of chromium in the aquifer would be expected 7,900 years in the future, 1 m from the edge of the source, at a concentration of 0.005 mg/L.
This concentration is a factor of 20 less than the MCL of 0.100 mg/L. Table 5.3.4–1 summarizes these modeling results.

The modeling of the CWL performed for this SWEIS is intended to provide a general estimate of future concentrations of TCE and chromium. It is not intended to substitute for SNL/NM ER Project modeling that may be performed to determine proper procedures for remediation.

Summary of Groundwater Impacts

Although there appears to be no immediate or long-term threat to human health through contamination of the water supply, there is short-term, localized degradation of the aquifer beneath the CWL from vapor-transported TCE. The area of degradation will decrease once cleanup near the ground surface begins to remove the source of the contamination. The presence, concentration, and location of this contamination are independent of any of the alternatives analyzed in the SWEIS. The contamination is a result of past waste management practices. Appropriate cleanup measures, developed in cooperation with the NMED, will proceed regardless of the alternative selected. Because of its effect on the aquifer, groundwater contamination at the CWL is identified as an adverse impact in the SWEIS.

5.3.4.2 Groundwater Quantity

The effects of continued SNL/NM groundwater usage on the aquifer in the KAFB vicinity were investigated. Projected usage under the No Action Alternative was compared with recent (1985-1996) usage and the associated changes to groundwater levels were estimated from recent trends.

Appendix B contains information showing historical pumpage rates from onsite KAFB wells and from Ridgecrest, the nearby Albuquerque well field. Future groundwater levels in the vicinity of KAFB are expected to be most dependent on pumpage from these wells.

Table 5.3.4–2 shows the recent and projected groundwater withdrawals. The proposed Mesa del Sol development (NMSLO 1997) was included in the projections because it would be a potential major contributor to groundwater usage in the vicinity of KAFB for the analysis period. The projected groundwater withdrawals were compared with historical withdrawals in order to establish a linear relationship for projecting future aquifer drawdown, which is also included in Table 5.3.4–2. SNL/NM groundwater use would account for 3 ft (11 percent) of drawdown over the 1998 to 2008 period. The distribution of the projected groundwater level declines in the vicinity of KAFB is indicated on Figure 5.3.4–3. Appendix B describes the method of projection, which includes considerations of population growth and the city of Albuquerque's goal of 30-percent reduction in per capita water use. SNL/NM's influence on drawdown would decrease with distance from KAFB. A one-dimensional Theis equation, assuming a 500 ft-thick aquifer and a hydraulic conductivity of 40 ft/day (Appendix B), indicates that 1 ft per yr or less of water level decline would be expected beyond 3 mi of KAFB wells from combined KAFB and SNL/NM water pumpage.

The city of Albuquerque San Juan/Chama Project is projected to begin operation in 2004 (COA n.d. [a]). The project will allow the city of Albuquerque, including Mesa del Sol, to meet its normal water demands from Rio Grande water. Groundwater withdrawals will be used only to supplement these normal demands. All of the city wells will remain online and ready for operation. Which wells will be operated (and how often and how much) has not yet been determined. Therefore, the San Juan/Chama Project has not been included in this analysis. It is expected that the Ridgecrest and Mesa del Sol well withdrawals would be substantially less than quantities used in this analysis.

Potential impacts of continued aquifer drawdown were identified and evaluated for the SWEIS. These were: exceedance of water rights (owned by KAFB); effects on well operations; effects on Pueblo of Isleta wells; effects on springs; and potential for land subsidence.

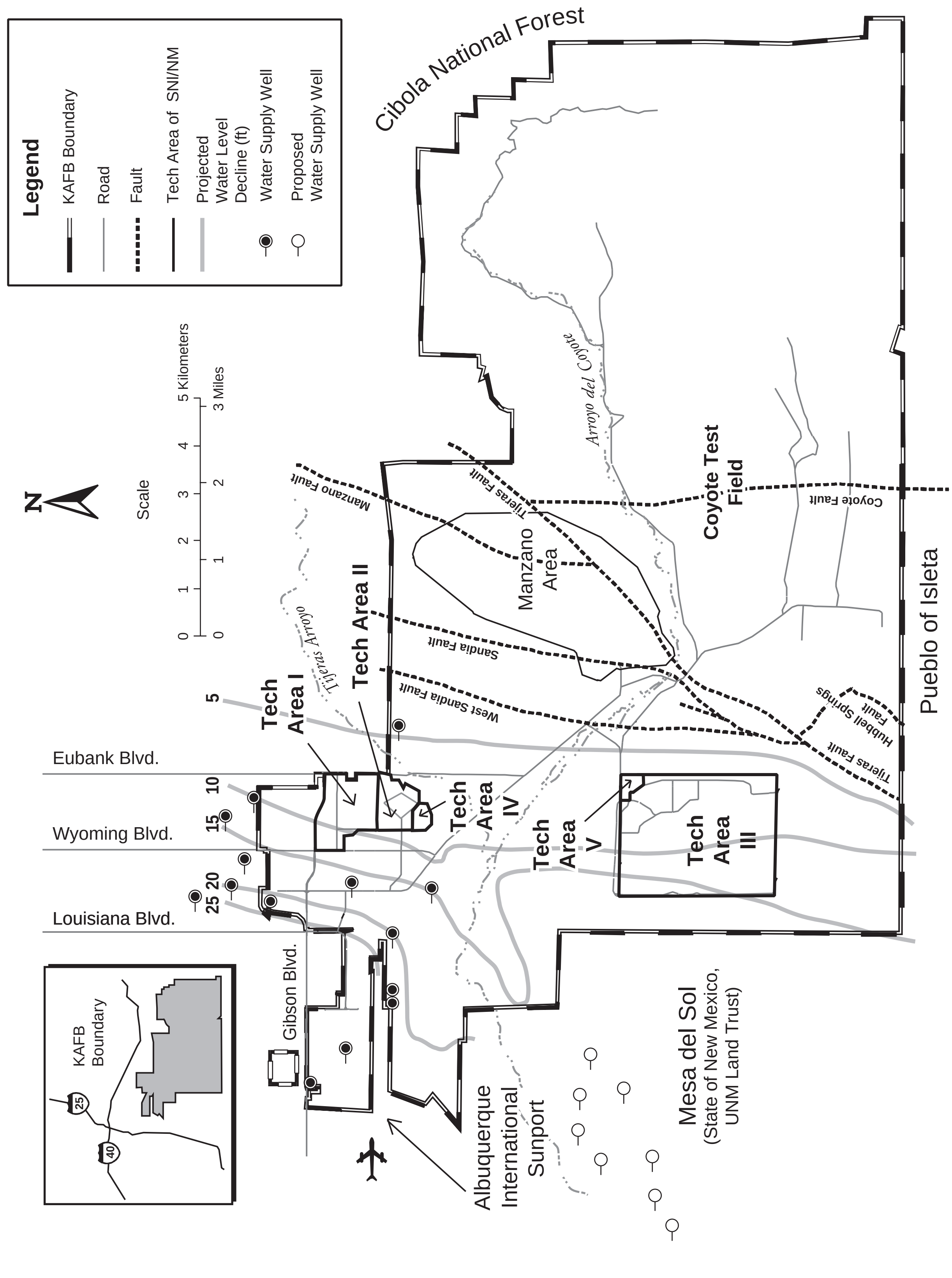
The maximum recent KAFB annual withdrawal was 235.7 M ft^3 (1992) (USGS 1995). KAFB withdrawals have been and are projected to remain significantly below the 278.7 M ft^3 per yr allowed by KAFB water rights (Bloom 1972).

KAFB area wells are typically screened from the water table surface to about 500 ft below the water table (USAF 1975, 1983). The wells are designed specifically for declining water levels with long screens and movable pumps. When groundwater levels drop below the pump, the pump can be lowered until it is submerged again. The pumps are typically installed about 80 ft beneath the water surface and are lowered when they are 20 ft below the water surface. Pumping wells located in areas projected to have 28 ft of decline over the 10-year period,

Table 5.3.4–2. Projected Groundwater Use and Water Level Declines in the Vicinity of KAFB

KAFB AREA CONTRIBUTOR	QUANTITY OF WATER WITHDRAWN IN 10 YEARS (1998 to 2008) (M ft^3)	MAXIMUM DRAWDOWN OVER 10-YEAR PERIOD (1998 to 2008) (ft)	PERCENT OF TOTAL DRAWDOWN CONTRIBUTION NEAR KAFB[a] (%)
Ridgecrest (city of Albuquerque)	3,243	16.8	61
KAFB (exclusive of SNL/NM)	829	4.3	15
SNL/NM	605	3.1	11
Mesa del Sol	683	3.5	13
TOTAL	**5,355**	**27.7**	**100%**

Source: SNL/NM 1998c [see also Appendix B, Table B.2–3]
ft: feet
ft^3: cubic feet
KAFB: Kirtland Air Force Base
M: million
SNL/NM: Sandia National Laboratories/New Mexico
Note: See Appendix B for details regarding calculations.
[a] Local effect (basin-wide effect is less than 1 percent.)



Sources: NMSLO 1997; SNL/NM 1997a, j

Figure 5.3.4–3. Projected Decline in Albuquerque-Belen Basin Groundwater Levels

During the period from 1998 to 2008, groundwater levels at KAFB are projected to decline as much as 28 ft, 11 percent of which would be from SNL/NM water use.

1998 to 2008 would require pump lowering in 22 years. If water was not being withdrawn for SNL/NM use, then the pumps would need to be lowered every 24 years. KAFB has also recently installed two new wells, (early June 1998), KAFB-15 and -16, in the northwest portion of the site. These wells are screened over a 1,000-ft interval from the water table surface, (approximately 500 ft below ground surface) to 1,500 ft below ground surface.

SNL/NM operations would not be expected to have an impact on Pueblo of Isleta wells. The Pueblo of Isleta boundary is approximately 6 mi from the nearest KAFB water supply well. Of the 1-ft water level decline projected at this boundary, up to 1 inch per year (11 percent) would be attributed to SNL/NM operations.

The effect of local drawdown on spring flow was also considered. However, all local springs are east of the fault zone, an area in which groundwater levels are not affected by pumping in the vicinity of KAFB.

The possibility of subsidence due to excess withdrawal was also investigated. The threshold for subsidence has been estimated as 260 to 390 ft of aquifer drawdown (Haneberg 1995) and recently refined to 330 to 490 ft (Haneberg 1997). Adding the almost 28 ft of maximum projected drawdown in the vicinity of KAFB to the basin-wide maximum of 160 ft (USGS 1993), which is actually located about 1 mi north of KAFB (about 2 mi north-northeast of TA-I), suggests that the projected water withdrawal would not result in land subsidence. The potential impacts described above would tend to diminish at greater distances from KAFB.

Summary of Groundwater Quantity Impacts

Although this analysis indicates that no immediate effects of the projected water level decline over the 1998 to 2008 period would be expected, SNL/NM water use would continue to contribute to the depletion of the aquifer. Because the rate of basin-wide groundwater withdrawal significantly exceeds the recharge rate, all groundwater users contribute to this depletion to some degree. SNL/NM's local drawdown effect would be measurable (3 ft over the 1998 to 2008 period), accounting for 11 percent of groundwater decline in the northern portion of KAFB under the No Action Alternative. Because of the magnitude of the effect on local water level decline, SNL/NM's groundwater withdrawal is identified as an adverse impact in the SWEIS.

5.3.4.3 Surface Water Quality

During storm events in 1994 and 1995, SNL/NM collected 32 surface water samples from onsite arroyos (Figure 5.3.4–4). A summary of analytical results from these samples is presented in Section 4.6.2. Contaminants of concern, which include dissolved metals, explosives, and radionuclides, were found only at trace concentrations (SNL/NM 1996g). Of greatest importance to the SWEIS analysis are four surface water samples collected from Tijeras Arroyo within 1 mi of its exit point from KAFB (Figure 5.3.4–4). These samples, collected on July 20 and August 22, 1995, are downstream from all SNL/NM facilities and operations. They represent two different kinds of runoff events: Tijeras Arroyo runoff from the July 20th storm event did not reach the Rio Grande, whereas, the August 22nd storm event had the largest daily average flow measured in Tijeras Arroyo (14 ft^3 per second at the farthest downstream gaging station) of the three days during 1995 when flow reached the Rio Grande (USGS 1998). Therefore, these samples are the best available indicators of what contaminants could reasonably be transported offsite to ultimately enter the Rio Grande approximately 7 mi farther downstream. These sample results show no contaminants above NMWQCC limits for the state-designated Tijeras Arroyo uses (livestock watering and wildlife habitat) (Table 5.3.4–3) (NMWQCC 1994). Furthermore, the August 22nd flow was only 2 percent of the 712 ft^3 per second measured at the nearest upstream gaging station on the Rio Grande for the same date; any contaminants in Tijeras Arroyo storm water runoff would likely be significantly diluted upon reaching the Rio Grande.

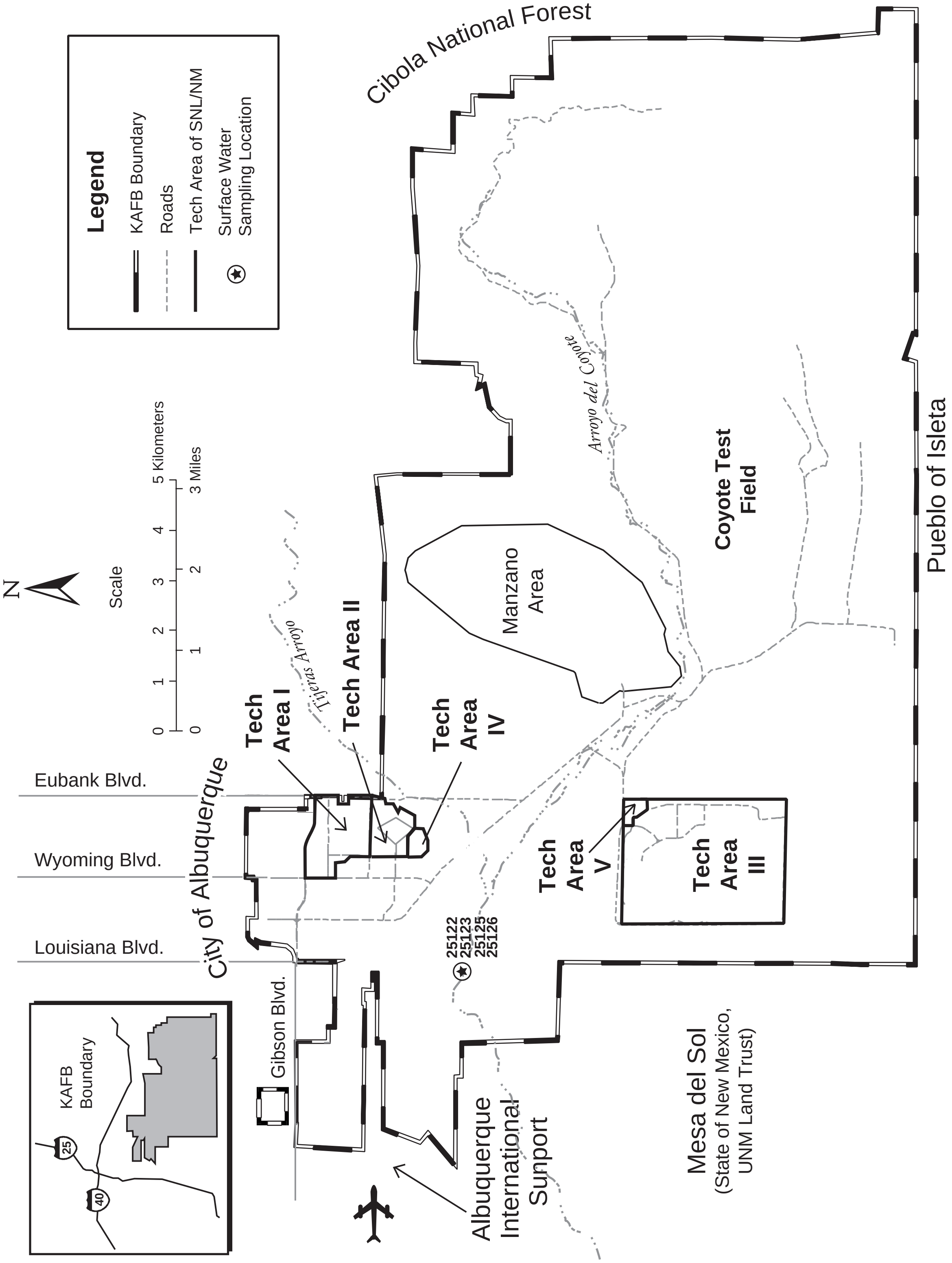
Potential Sources of Surface Water Contamination

Environmental Restoration Project Sites

Cleanup actions planned, underway, or completed at eight ER sites within 0.5 mi of Tijeras Arroyo or Arroyo del Coyote are intended to remove any potential source of surface water contamination, and the cleanup activities themselves are not expected to negatively affect surface water quality (DOE 1996c). The ER Project is scheduled for completion between FY 2003 and FY 2005, depending upon budget availability, with no projected variation in schedule under the No Action Alternative.

Permitted Storm Water Discharge

Surface water sampling results indicate storm water runoff from SNL/NM facilities in TAs-I, -II, and -IV



Sources: SNL 1995c , SNL/NM 1997j

Figure 5.3.4–4. Surface Water Sampling Locations at Tijeras Arroyo

Four surface water samples were collected from Tijeras Arroyo near the exit point from KAFB.

Table 5.3.4–3. Tijeras Arroyo Storm Water Sampling Results Near Downstream Boundary of KAFB (New Mexico Water Quality Control Commission-Listed Contaminants)

PARAMETER	UNITS	SAMPLING LOCATIONS[a]				NMWQCC LIMIT[b]
		25122	25123	25125	25126	
Aluminum	mg/L	0.67	0.048	ND	ND	5.0
Arsenic	mg/L	ND	ND	ND	ND	0.2
Boron	mg/L	NA	NA	NA	NA	5.0
Cadmium	mg/L	ND	ND	ND	ND	0.05
Chromium	mg/L	ND	ND	ND	ND	1.0
Cobalt	mg/L	ND	ND	ND	ND	1.0
Copper	mg/L	ND	0.01	ND	ND	0.5
Lead	mg/L	ND	ND	ND	ND	0.1
Mercury (total)	mg/L	ND	ND	ND	ND	0.000012[c]
Selenium	mg/L	ND	ND	ND	ND	0.002[c]
Vanadium	mg/L	ND	0.006	ND	ND	0.1
Zinc	mg/L	0.16	0.003	ND	ND	25.0
Radium-226, -228	pCi/L	NA	NA	NA	NA	30.0
Tritium	pCi/L	NA	NA	NA	NA	20,000
Gross alpha	pCi/L	NA	NA	NA	NA	15

Sources: NMWQCC 1994, SNL/NM 1996g
mg/L: milligrams per liter
NA: not analyzed
ND: not detected
NMWQCC: New Mexico Water Quality Control Commission
pCi/L: picocuries per liter
[a] Locations shown in Figure 5.3.4–4
[b] Limit for livestock watering use
[c] Limit for wildlife habitat (most stringent)

does not contribute contaminants to Tijeras Arroyo. Under the No Action Alternative, no new activities are forecast in TAs-I, -II, or -IV that would cause contamination of storm water runoff (SNL/NM 1998a). The projected increase in SNL/NM staffing, 5 percent over current levels under the No Action Alternative (Section 5.3.12), could lead to runoff of additional organic compounds (primarily oil and grease) from vehicles in parking lots. The most recent storm water monitoring shows oil and grease concentrations ranging from 0.6 to 1.4 mg/L (SNL 1997d). Although there are no quantitative National Pollutant Discharge Elimination System (NPDES) or state limits for oil and grease, these concentrations are near detection limits. A 5-percent increase in these values would be of no environmental consequence, especially considering dilution that would occur in Tijeras Arroyo during periods of runoff.

Outdoor Testing Facilities

A slight increase in outdoor testing activities is projected under the No Action Alternative, and some types of tests may double (SNL/NM 1998a). However, controls are in place to minimize the amount of soil contamination that could occur during these tests, including posttest surveys and material removal (SNL 1997e). Because no surface water radionuclide concentrations have been detected above background under current test levels, contamination is not anticipated under test levels projected for the No Action Alternative.

5.3.4.4 Surface Water Quantity

Storm Water Runoff

By calculating the difference between runoff that would occur from a natural surface and an impervious surface, the net contribution of SNL/NM to runoff can be established. The percentage of rainfall that runs off natural surfaces at SNL/NM is estimated at 10 to 35 percent (SNL/NM 1997a), varying with factors such as slope, vegetation, and soil type. For this analysis, the increase in storm water runoff at SNL/NM was estimated by assuming that 100 percent of rainfall would run off areas with buildings and parking lots. Although the actual runoff percentage would be less because of pooling and evaporation of water on these surfaces, the 100-percent assumption provides a maximum estimate (greatest environmental effect) for the SNL/NM contribution to surface water quantity. The lower estimate of 10 percent was used for natural runoff, also to provide a maximum estimate of the SNL/NM contribution to storm water runoff. The calculations used in this analysis are shown in Appendix B.

The developed (impervious) area of SNL/NM is estimated to be 0.72 mi^2. This analysis indicates that SNL/NM contributes no more than 5 percent of the flow in Tijeras Arroyo. The maximum increase in annual surface runoff due to the presence of SNL/NM is estimated to have ranged from approximately 100,000 to 700,000 ft^3 from 1993 through 1995. These flows represent small fractions (0.0001 to 0.001 percent) of the annual Rio Grande flow above its confluence with Tijeras Arroyo.

Under the No Action Alternative, only minor net changes in building and parking lot areas would be anticipated. Annual variations in SNL/NM surface runoff would be likely; however, the overall impact would be minimal.

Discharge to Sanitary Sewer

During 1996, 37.4 M ft^3 (280 M gal) of SNL/NM process and sanitary sewage water were discharged to the city of Albuquerque's Southside Water Reclamation Plant (SNL/NM 1997a). This water, which is treated and then discharged to the Rio Grande, 0.7 mi upstream of the river's confluence with Tijeras Arroyo, contributes approximately 0.06 percent to the 60.5-B-ft^3 annual average flow (upstream of the water reclamation plant) measured from 1993 through 1995 (USGS 1998).

Under the No Action Alternative, annual discharge to the sanitary sewer would be expected to increase slightly from the 1996 level to 40.6 M ft^3 (304 M gal). This would result in a contribution to Rio Grande flow of 0.07 percent. SNL/NM management has committed to a 30-percent reduction in water use by 2004 (SNL/NM 1997a). A decrease in the quantity of water discharged to the reclamation plant would be expected under this plan.

Based on this analysis, the total annual contribution of water to the Rio Grande from SNL/NM, including surface water runoff and discharge to the Southside Water Reclamation Plant, would be between 40.7 and 41.3 M ft^3 under the No Action Alternative. The vast majority of this contribution (40.6 M ft^3) would come from discharge to the water reclamation plant. The total SNL/NM contribution would be approximately 0.07 percent of the average annual Rio Grande flow. No discernible effects to the Rio Grande would be likely from the quantity of SNL/NM water discharged.

5.3.5 Biological and Ecological Resources

Implementation of the No Action Alternative would cause minimal impacts to biological and ecological resources. The ROI for biological resources consists of KAFB, the Withdrawn Area, buffer zones associated with operations in TA-III, and any adjacent lands that the No Action Alternative would affect.

Biological resources could be influenced by construction activities or outdoor operations that result in noise, projectiles, off-road vehicular traffic, unintended fires, and plumes of smoke. Radionuclides or chemicals could also be released from potential accidents or normal operations.

SNL/NM operations in TAs-I, -II, and -V would continue to occur primarily within buildings. Under the No Action Alternative, any proposed construction was analyzed and approved in separate NEPA documents (see Section 1.7): *Environmental Assessment for the Processing and Environmental Technology Laboratory* (DOE 1995d); *Environmental Assessment for Operations, Upgrades, and Modifications in SNL/NM Technical Area IV,* (DOE 1996g); *Neutron Generator/Switch Tube (NG/ST) Prototyping Relocation Environmental Assessment,* (DOE 1994a); and the *Environmental Assessment for the Radioactive and Mixed Waste Management Facility,* (DOE 1993a). Small areas of vegetation would be removed as a result of some of these projects, but the viability of the plant communities would not be affected. Proposed activities would likely result in the local displacement of wildlife; however, the impact would be minimal and temporary.

Wildlife species at KAFB are representative of those present in the areas surrounding KAFB. From observation, wildlife appears to have become accustomed to the noise and activities that currently exist. Data from raptor surveys at KAFB support this observation, because some raptor species at KAFB return to the same nest sites each year. For example, the western burrowing owl and Swainson's hawk migrate to KAFB to breed in the same nests (USAF 1997b).

A 1997 raptor survey was conducted for the USAF as part of its Management Strategies on KAFB and the Withdrawn Area of the Cibola National Forest. A total of 59 raptors were observed (USAF 1997b). Burrowing owls constituted 49 percent of the observations. No peregrine falcons were observed in the survey.

The USFS completed its ecosystem management plan for the Withdrawn Area in March, 1996 (USFS 1996). This study confirmed that there has been no positive identification of a peregrine falcon to date.

Outdoor activities at TA-III and the Coyote Test Facility would continue to affect small localized areas. At the Aerial Cable Facility, 2.2-lb antitank skeet warheads would continue to be detonated. Small fragments of explosive test debris and shrapnel would potentially be dispersed over a 1,200-ft radius (SNL/NM 1998a). Such debris would have a minimal impact on the mortality or distribution of plants and animals. At the Lurance Canyon Burn Site, tests using fire are conducted in outdoor pools, the largest of which is 1,800 ft^2 (SNL/NM 1998a). Normal operations at these sites would potentially result in unintended fires of limited areal extent. As a result, a temporary loss of vegetation would occur. A few one-seed junipers and grasses would potentially be lost in a fire. Desert shrubs are only marginally affected by fire (Dick-Peddie 1993). Perennial grasses appear to recover from fire less effectively than shrubs or forbs (Dick-Peddie 1993). However, the immediate effects on perennial grasses may last only 1 or 2 years (Cable 1967). Although relationships between fire and vegetation are complex, it is unlikely that fires or their suppression have had much effect on the scrublands or nonmontane grasslands of New Mexico (Dick-Peddie 1993). Individuals of the grama grass cactus, a USFS sensitive species, would possibly be destroyed in a fire, but seeds would survive (PSL 1992). The population would recover, and the temporary impact on this species would be minimal.

Normal operations at the Lurance Canyon Burn Site would result in large plumes of carbon particulates that would extend thousands of feet into the air (SNL/NM 1998a). These smoke plumes would be of short duration and would temporarily displace birds.

Under the No Action Alternative, there would be no impact on springs or wetlands, including the Burn Site Spring, the only spring or wetland on land used by SNL/NM.

Under the No Action Alternative, the federally endangered peregrine falcon would not be affected. There would not be a loss, gain, or degradation to the habitat of peregrine falcons. While peregrine falcons are regular spring migrants along ridge lines of the Sandia and Mazano Mountains, only one probable sighting of a peregrine falcon, which was likely migrating, has been documented during surveys on the KAFB. No evidence of nesting has been found on KAFB, which has marginal nesting potential (USAF 1995d). Prey availability for any migrating falcons would also not be affected by continued and planned operations. Impacts to other protected or sensitive species, or both, would be negligible.

On August 25, 1999, the USFWS delisted the American peregrine falcon from the Federal list of endangered and threatened wildlife. The USFWS has determined that this species has recovered following restrictions on the use of organochlorine pesticides (dichloro-diphenyl-trichloroethane [DDT]) in the United States and Canada, and following the implementation of successful management activities (64 FR 46541).

Ecological risks of the DOE's ongoing environmental restoration activities were analyzed in the *Environmental Assessment of the Environmental Restoration Project at SNL/NM* (DOE 1996c). Results indicate that removing soil that has been contaminated by radioactive or hazardous materials would reduce the potential for exposure of animals and plants to these contaminants and any associated ecological risk. Corrective actions could generate contaminated dust and subsequent exposure of small mammals and plants to radionuclides, cadmium, chromium, and lead. The predicted exposures were well below the benchmark levels, above which adverse effects are a potential concern. This indicates that biota would be at minimal risk for adverse effects from contaminated dust and radiation (DOE 1996c).

Annual ecological monitoring of small mammal, reptile, amphibian, bird, and plant species at selected sites does not show significant contaminant loads of radionuclides or metals in the individuals tested (SNL/NM 1997u). This indicates that no significant contaminant loadings of radionuclides or metals would likely be found in biota traveling across the boundaries between the KAFB and the Pueblo of Isleta. Ecological risks to plants and animals would continue to be further assessed using a phased approach outlined by the EPA (SNL/NM 1998w). The exposures of indicator plant and animal species to constituents of potential ecological concern would be modeled in order to calculate hazard quotients. For example, perennial grasses, small mammals, and insects would be collected at selected ER sites and analyzed for the concentrations of selected metals, included uranium and lead (SNL/NM 1998w). No significant increases in contaminant loads of radionuclides or chemicals would be expected in plants or animals at KAFB under the No Action Alternative. Removal of contaminated soil would result in a short-term loss of vegetation and disturbance of wildlife.

Inventory and management of the biological resources by SNL/NM, KAFB, and the USFS would continue to protect the animals, plants, and sensitive species on KAFB.

5.3.6 Cultural Resources

The implementation of the No Action Alternative would have low to negligible impacts to cultural resources due to 1) the absence of cultural resource sites on DOE-administered land, 2) the nature of the cultural resources found in the ROI (see Appendix C), 3) compliance with applicable regulations and established procedures for the protection and conservation of cultural resources located on lands administered by the DOE and on lands administered by other agencies and used by the DOE (see Section 4.8.3.2 and Chapter 7), and 4) the largely benign nature of SNL/NM activities near cultural resources. Implementation of the regulations and procedures would make unlikely any adverse impacts resulting from construction, demolition, decontamination, renovation, or ER Project activities.

No impacts would be anticipated to DOE buildings constructed during World War II or the Cold War era, some of which are eligible or potentially eligible for listing on the National Register of Historic Places (NRHP). Although some buildings on DOE-owned land have been assessed for eligibility, most have not because of their young age. Some of the buildings at SNL/NM have been proposed for decontamination, renovation, or demolition. Before any building is subjected to these activities, the DOE would assess the eligibility of the building for placement on the NRHP and, in consultation with the New Mexico SHPO, would determine if the activities would have an impact on an eligible building. This assessment would include determining measures to mitigate or avoid any potential impacts to eligible buildings.

Under the No Action Alternative, prehistoric and historic cultural resources could potentially be affected by activities performed at five SNL/NM facilities, although the potential for impact is low to negligible. These facilities consist of the Aerial Cable Facility, Lurance Canyon Burn Site, Thunder Range, Sled Track Complex, and Terminal Ballistics Complex. The first three facilities are located on land not owned by the DOE. Impacts could potentially result from three activities at these facilities: production of explosive testing debris and shrapnel, off-road vehicle traffic, and unintended fires and fire suppression. Another source of potential impact derives from the restricted access present at KAFB and individual SNL/NM facilities. Discussions of potential impacts follow and are organized by impact source.

5.3.6.1 Explosive Testing Debris and Shrapnel

One source of potential impact to cultural resources would be explosive testing debris and shrapnel (referred to as debris) produced by outdoor explosions. Such explosions could cause the impact of airborne debris on cultural materials or the presence of debris on cultural resource sites. Activities at two SNL/NM facilities—the Aerial Cable Facility and the Lurance Canyon Burn Site—would have the potential for impacts to cultural resources due to debris from outdoor explosions. The potential for impacts would be low for both facilities, as explained below.

Activities at the Aerial Cable Facility would include testing antitank skeet warheads weighing approximately 2.2 lb. During the tests, which would be conducted in target areas that have previously been disturbed, the warheads would explode, dispersing debris (SNL/NM 1998a). Studies conducted at Los Alamos National Laboratory (LANL) for explosive tests measuring up to 500 lb have shown that debris primarily tend to fall within 800 ft of the firing site and no particles fall outside 1,200 ft (DOE 1998a).

No archaeological sites are located within an 800-ft radius of the Aerial Cable Facility. One eligible archaeological site is located within a 1,200-ft radius, where debris would be likely to fall less frequently. Both the position of this site on a hill slope facing away from the facility and the surrounding vegetation would act to reduce both the velocity and amount of debris that could reach the site, thereby lowering the already low probability for impacts caused by debris. Dense pinyon and juniper trees and shrubs are present in the area, which would help protect the archaeological resource from airborne debris. Field observations conducted at this archaeological site in August 1998 by the SWEIS Cultural Resources Specialist did not reveal any visible effects that could be attributable to flying debris and no debris was identified on the site. Based on these studies, the probability of this one archaeological site being affected by flying debris from the facility would be low.

Activities at the Lurance Canyon Burn Site could result in unintended explosions that could disperse debris. Four archaeological sites (all NRHP eligible) are located within 800 ft of the facility and three archaeological sites (two eligible and one potentially eligible) are within the 800- to 1,200-ft range. For the same reasons stated above for the Aerial Cable Facility, the potential for impacts to these sites from debris would be low. In addition, for some burn tests at the Lurance Canyon Burn Site, barriers are erected around test sites to contain fragments in the event of an unintended explosion, thereby reducing the already low potential for impacts to cultural resources. Field observations conducted at these seven archaeological sites in August 1998 by the SWEIS Cultural Resources Specialist did not reveal any visible effects that could be attributable to debris.

5.3.6.2 Off-Road Vehicle Traffic

Off-road vehicle traffic would be another possible source of impact to cultural resources. Activities at Thunder Range would sometimes require off-road vehicle travel to place objects for object detection activities, although most targets and reflectors would be placed along existing dirt roads and would usually not require off-road travel. There is one potentially eligible archaeological site on Thunder Range near a dirt road. Off-road vehicle travel could physically affect this site; however, personnel working in the area are aware of its location and the need to avoid it. Therefore, the potential for impacts to this site would be negligible. Field observations conducted at this site in August 1998 by the SWEIS Cultural Resources Specialist did not reveal any visible effects due to off-road vehicle travel.

5.3.6.3 Unintended Fires and Fire Suppression

Fires and fire suppression activities can cause physical damage to cultural resources. After a fire, the lack of vegetation can allow sheet-washing during rainstorms, thereby eroding exposed resources and causing further physical damage. Activities at four facilities—the Terminal Ballistics Complex, Sled Track Complex, Aerial Cable Facility, and Lurance Canyon Burn Site—would have the potential to ignite accidental outdoor brush fires. However, the potential for subsequent impacts to cultural resources would be low to negligible for a number of reasons. First, fires would be expected to occur close to the originating facility. Personnel would be aware of the potential for such fires and trained to spot and extinguish them. Second, personnel would access the fire on foot and suppress it using portable chemical extinguishers or extinguishing blankets. Third, SNL/NM and the DOE would coordinate with KAFB and the USFS monthly to review scheduled activities with regard to the current fire hazard conditions and to determine if activities should be coordinated on a day-to-day basis (when the fire hazard is high). The Terminal Ballistics Complex and the Sled Track Complex are 1 mi or more away from any known cultural resources; thus, the probability for unintended fires and fire suppression activities from these facilities to affect these resources would be negligible. The other two facilities, the Aerial Cable Facility and the Lurance Canyon Burn Site, are in areas that contain many archaeological sites, with some sites located within 1,200 ft of the facilities. However, due to the training of personnel to identify and extinguish fires quickly, access them on foot, and use fire suppression methods that minimize ground disturbance, the probability for impacts to the archaeological sites at these two facilities would remain low.

5.3.6.4 Restricted Access

Restriction of access to areas within the ROI would have positive effects on cultural resources themselves. Under the No Action Alternative, current KAFB security levels that restrict access would remain. Additional access restrictions would be enforced at specific SNL/NM facilities during various activities. These restrictions would result in an increased level of protection for cultural resources in the ROI and particularly in the facility secure zones.

Consultations to identify TCPs were conducted. Fifteen Native American tribes have been contacted to determine the presence of TCPs in the ROI. Some tribes who traditionally used the area surrounding and including KAFB consider certain categories of features to be TCPs because of their sacred or religious association with the group or their use by the group in traditional lifeways. These features, which are present in the ROI, include archaeological sites, human burials, springs and other water sources, minerals, vegetation, and animals. However, no specific TCPs have been identified through these consultations and no TCPs are currently known to exist within the ROI. Consultations will continue with some of the tribes. If specific TCPs are identified in the future, any impacts of SNL/NM activities on the TCP and any impacts of restricting access to the TCP would be determined in consultation with Native American tribes.

5.3.7 Air Quality

The implementation of the No Action Alternative would continue the nonradiological and radiological emissions (Sections 5.3.7.1 and 5.3.7.2, respectively) from SNL/NM facilities. These emissions would continue to be well within the applicable standards for public and worker health and safety.

5.3.7.1 Nonradiological Air Quality

Local, state, and Federal regulations require Federal agencies to assess the effect of their activities on ambient air quality. Under Section 176 (c) of the *Clean Air Act* (CAA), each Federal agency has an affirmative responsibility to ensure that the agency's activities conform to state implementation plans designed to achieve and maintain the NAAQS.

Air emissions were assessed for compliance with the NAAQS, and the NMAAQS, and the Albuquerque/Bernalillo County Air Quality Control Board (A/BC AQCB) regulations for criteria pollutants and guidelines for chemical concentrations. The A/BC AQCB enacted the General Conformity Regulation in November 1994 in the Air Quality Control Regulation (20 NMAC 11.04). A final Federal rule for *Determining Conformity of General Federal Actions to State or Federal Implementation Plans* was promulgated by the EPA on November 30, 1993 (58 FR 63214), and took effect on January 31, 1994 (40 CFR Parts 6, 51, and 93). This Federal rule established the conformity criteria and procedures necessary to ensure that Federal actions conform to the appropriate state implementation plan (SIP) and meet the provisions of the CAA until the required conformity SIP revision by the state is approved by the EPA. In general, the final rule ensures that all criteria air pollutant emissions and volatile organic compounds (VOCs) are specifically identified and accounted for in the SIP's attainment or maintenance demonstration. This final rule establishes the criteria and procedures governing the determination of conformity for all Federal actions, except Federal highway and transit actions ("transportation conformity"). In addition, at the state level are the provisions of *Conformity of General Federal Actions to the State Implementation Plan* passed on December 14, 1994, which echo the Federal conformity rule. These conformity regulations apply to nonattainment or maintenance areas for criteria pollutants. Bernalillo county is currently classified as a maintenance area for carbon monoxide and therefore these regulations apply to the current Federal actions at SNL/NM.

Criteria Pollutants

The nonradiological air quality for criteria pollutants at SNL/NM under the No Action Alternative is represented by 1996 baseline sources, plus those criteria pollutants sources expected to become operational by 2008. The criteria pollutants include PM_{10}, sulfur dioxide, carbon monoxide, nitrogen dioxide, lead, TSP, and ozone. The No Action Alternative provides for SNL/NM to operate at current planned levels, which would include emission sources that are planned or under construction. These planned sources include a boiler designated by the Albuquerque Environmental Health Department (AEHD) as "insignificant," an emergency generator in Building 701 (currently under construction), and a 600-kw-capacity generator in Building 870b.

Following are the criteria pollutant sources included in the modeling analysis under the No Action Alternative:

- the steam plant,
- the electric power generator plant,
- a boiler and an emergency generator in Building 701, and
- the 600-kw-capacity generator in Building 870b.

"Insignificant" Source

An "insignificant" source is a source that is listed by the Albuquerque Environmental Health Department (AEHD) or approved by the [EPA] Administrator as insignificant on the basis of size, emissions, or production rate.

Source: 20 NMAC 11.42

The Lurance Canyon Burn Site is an additional source of criteria pollutants. This source is a noncontinuous source, spatially separated from those listed above, and is, therefore, addressed separately within the fire testing facilities section that follows.

The estimated emissions of criteria pollutants under the No Action Alternative were modeled using the EPA-recommended *ISCST3* (version 97363) model to estimate concentrations of criteria pollutants at or beyond the SNL/NM boundary, including receptor locations such as public access areas (for example, the National

Atomic Museum, hospitals, and schools). Onsite hourly meteorological data from meteorological tower A15 for 1995 and 1996 and from meteorological tower A21 for 1994, 1995, and 1996, were used to perform the modeling. Figure 5.3.7–1 shows the locations of the two meteorological towers in the vicinity of TA-I.

Modeling results for nitrogen oxides using *ISCST3* for the 24-hour and annual averaging periods are 0.19 ppm (300 $\mu g/m^3$) and 0.02 ppm (28 $\mu g/m^3$), respectively. The NMAAQS standards for nitrogen dioxide for the 24-hour and annual averaging periods are 0.10 ppm (156 $\mu g/m^3$) and 0.05 ppm (78 $\mu g/m^3$), respectively. The modeling results indicate that the nitrogen oxides 24-hour concentrations exceed the NMAAQS standard for nitrogen dioxide. If the nitrogen oxides concentration is below the NMAAQS standard for nitrogen dioxide, then no further analysis is necessary to show compliance with the standard. Since the nitrogen oxides concentration is above the standard, a second step must be undertaken to show compliance. The second step implements the OLM to estimate nitrogen dioxide concentrations in modeled nitrogen oxides emissions.

Receptor Location

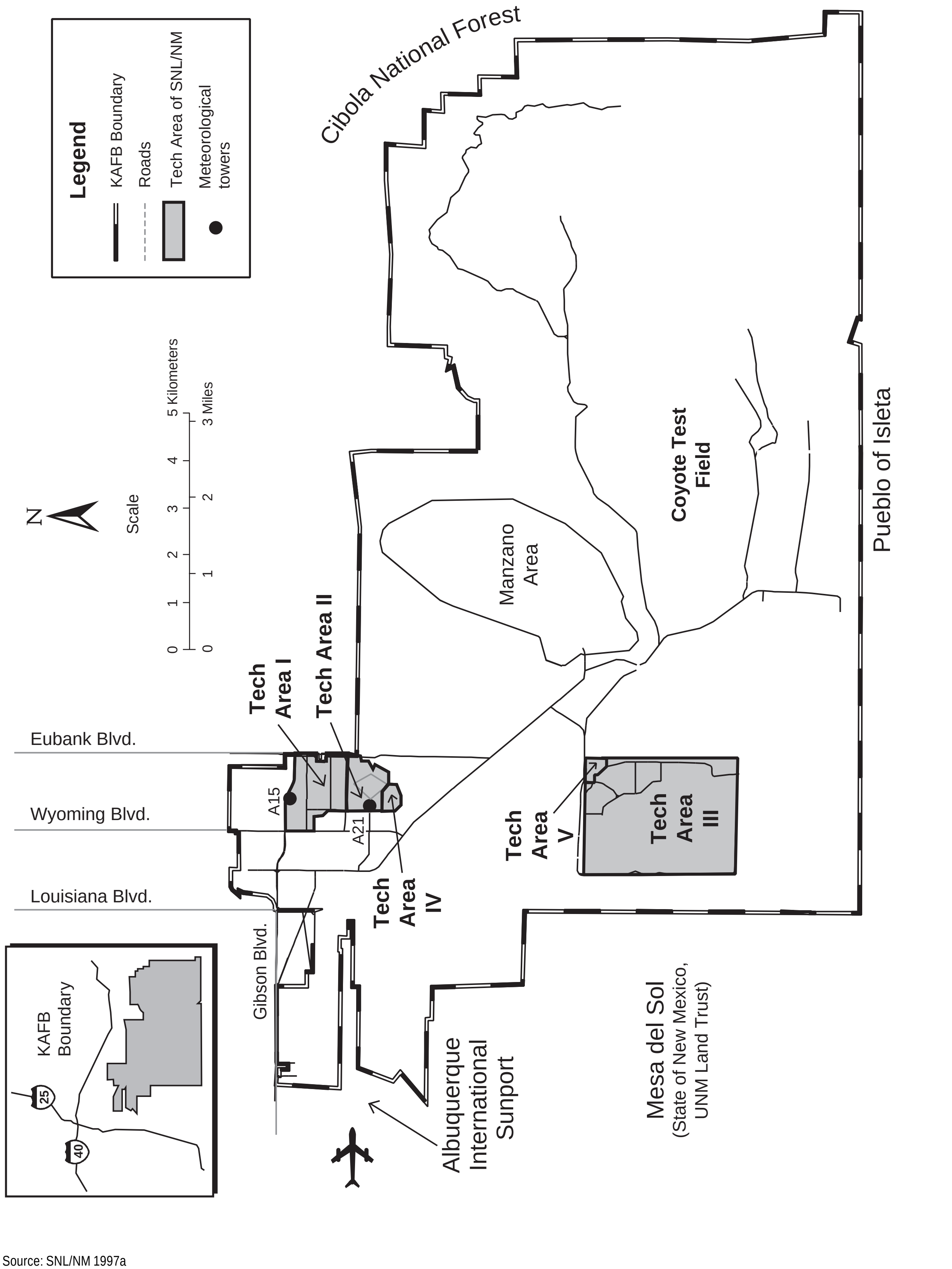
A receptor location is a location at which any individual may be affected by SNL/NM activities.

The New Mexico Air Quality Bureau has approved the OLM to estimate nitrogen dioxide concentrations in modeled nitrogen oxides emissions. A detailed description of the OLM is presented in Appendix D. The OLM results in a modeled annual average concentration of nitrogen dioxide of 0.006 ppm (10 $\mu g/m^3$) and a 24-hour average concentration of 0.066 ppm (103.7 $\mu g/m^3$). The OLM requires that background nitrogen dioxide concentrations be added to the model-calculated nitrogen dioxide concentrations to obtain a representative concentration of nitrogen dioxide. The maximum 24-hour average concentration of nitrogen dioxide at the chosen background station in 1996 was 0.029 ppm (46 $\mu g/m^3$); the annual average concentration was 0.008 ppm (13 $\mu g/m^3$). The future contribution from the Cobisa Power Station, located approximately 5 mi west of SNL/NM, will add to the annual average background concentration of nitrogen dioxide at the monitoring station. The calculated maximum incremental annual average nitrogen dioxide concentration from this facility will be 1.1 $\mu g/m^3$. These values, added to the modeled values of nitrogen dioxide, are reported in Table 5.3.7–1. Potential increases in the background for other criteria pollutants, due to the Cobisa Power Station, are also included. The maximum criteria pollutant concentrations at a public access area outside of the SNL/NM fence occurred at the National Atomic Museum. Table 5.3.7–1 presents the criteria pollutant concentrations of carbon monoxide, nitrogen dioxide, PM_{10}, TSP, and sulfur dioxide resulting from the modeling analysis, and maximum measured monitoring data for lead and ozone. In addition,

What is a Background Concentration?

Manufacturing processes may produce toxic, hazardous, and radioactive substances, either directly or as byproducts. However, many of these substances also occur naturally and can be found in air, water, and soils. Examples include: volatile chemicals produced by forests and phytoplankton; radioactive nuclides, such as uranium, radium, tritium, and beryllium, created by cosmic radiation; and all nonradioactive metals such as lead, chromium, nickel, and arsenic. In order to determine the amount of these substances in the environment resulting from human activity, it is necessary to subtract the naturally occurring or background concentrations from the concentrations measured in a finite number of environmental samples. Because background concentrations can vary substantially over an area and with depth, a difference between sample and background concentrations does not necessarily demonstrate that contaminants have been introduced into the environment.

Determining whether concentrations of metals or radionuclides are the result of contaminants introduced into the environment tends to be more problematic than situations involving volatile chemicals. Various metals and radionuclides occur naturally in measurable concentrations, and the amount of contamination introduced is often relatively small compared to the background values. To aid in the interpretation of metal and radionuclide concentrations in samples, SNL/NM conducted a study of background concentrations at KAFB (SNL/NM 1996e). Using more than 3,700 samples, SNL/NM demonstrated the variation in natural concentrations of 20 metals and 9 radionuclides in different regions of KAFB. This study was the basis for developing a set of agreed-upon maximum background concentrations with the NMED.



Source: SNL/NM 1997a

Figure 5.3.7–1. Locations of Meteorological Towers Used for Criteria Pollutant Modeling

Two meteorological towers (A15 and A21) in the TA-I vicinity were used to perform modeling for criteria pollutants.

Table 5.3.7-1. Criteria Pollutant Concentrations from SNL/NM Stationary Sources and Background with Applicable National and New Mexico Ambient Air Quality Standards Under the No Action Alternative

POLLUTANT (SNL/NM [Tons/yr])	AVERAGE TIME	NAAQS (ppm[µg/m^3])	NMAAQS (ppm[µg/m^3])	NO ACTION CONCENTRATION (ppm[µg/m^3])	BACKGROUND CONCENTRATION (ppm[µg/m^3])	TOTAL CONCENTRATION (ppm[µg/m^3])	PERCENT OF STANDARD[i]
Carbon Monoxide (18.36)	8 hours	9[8,564]	8.7[8,279]	0.08[78.4]	4.9[4,663][g]	4.98[4,741]	57
	1 hour	35[33,305]	13.1[12,466]	0.13[119]	8.0[7,613][g]	8.1[7,732]	62
Lead	Quarterly	1.5[a]	-	0.001[a,b]	-	0.001[a,b]	0.07
Nitrogen Dioxide (162.36)	Annually	0.053[83]	0.05[78]	0.006[10.0]	0.009[14.1][f,g]	0.015[24.1]	30
	24 hours	-	0.10[156]	0.066[103.7]	0.029[46][f,g]	0.096[149.7]	96
TSP (7.46)	Annually	-	60[a]	11.4[a]	30[h]	41.4[a]	69
	30 days	-	90[a]	NA	NA	NA	NA
	7 days	-	110[a]	NA	NA	NA	NA
	24 hours	-	150[a]	114.2[a]	30[h]	144.2[a]	96
PM_{10}[d] (7.46)	Annually	50[a]	-	11.4[a]	30[h]	41.4[a]	83
	24 hours	150[a]	-	114.2[a]	30[h]	144.2[a]	96
Sulfur Dioxide (1.10)	Annually	0.03[65]	0.02[44]	0.0008[1.7]	0.00005[0.12][f]	0.00085[1.82]	4
	24 hours	0.14[305]	0.10[218]	0.006[12.2]	0.0008[1.7][f]	0.006[13.9]	6
	3 hours	0.50[1,088]	-	0.01[21.1]	0.006[13.5][f]	0.016[34.6]	3
Ozone[e]	1 hour	0.12[196]	-	0.103[168] [c]	-	0.103[168] [c]	86
Hydrogen Sulfide	1 hour	-	0.01/12	NA	-	NA	NA
Total Reduced Sulfur	0.5 hour	-	0.03/33	NA	-	NA	NA

Sources: 20 NMAC 2.03, 40 CFR Part 50, NMAPCB 1996, SNL/NM 1997d
mg/m^3: micrograms per cubic meter
CPMS: criteria pollutant monitoring station
NA: Not Available
NAAQS: National Ambient Air Quality Standards
NMAAQS: New Mexico Ambient Air Quality Standards
PM_{10}: Particulate matter less than 10 microns in diameter
ppm: parts per million
TSP: total suspended particulates
[a] mg/m^3
[b] Highest quarterly lead monitoring data measured at the CPMS site in 1996
[c] Highest 1-hour ozone monitoring data measured at the CPMS site in 1996
[d] PM_{10} assumed equal to TSP
[e] A new 8-hour, 0.08-ppm ozone standard is replacing the previous 1-hour, 0.12-ppm ozone standard based on the most recently available 3 years of ozone data. SNL/NM might not be in compliance with this standard in the year 2000 when the EPA will designate areas that do not meet the 8-hour standard.
[f] Background concentrations resulting from operation of the Cobisa Power Station
[g] 1996 maximum background concentrations from monitoring station 2R and/or 2ZR/2ZQ.
[h] Background PM_{10} values for 24-hour and annual PM_{10} cumulative impacts (NMAPCB 1996).
[i] Represents SNL/NM contribution plus background as a percent of standard.
Note: The standards for some of the pollutants are stated in ppm. These values were converted to mg/m^3 with appropriate corrections for temperature (530 degrees Rankin) and pressure (elevation 5,400 feet) following New Mexico Dispersion Modeling Guidelines (NMAPCB 1996).

Table 5.3.7–2. Incremental Criteria Pollutant Concentrations from SNL/NM Stationary Sources with Applicable National and New Mexico Ambient Air Quality Standards

POLLUTANT	AVERAGING TIME	NAAQS (ppm[μg/m³])	NMAAQS (ppm[μg/m³])	INCREMENTAL CONCENTRATION (ppm[μg/m³])	PERCENT OF STANDARD
Carbon Monoxide	8 hours	9[8,564]	8.7[8,279]	0.03[29.7]	< 1
	1 hour	35[33,305]	13.1[12,466]	0.2[164.7]	1.3
Lead	Quarterly	1.5[a]	-	NA	NA
Nitrogen Dioxide[b]	Annual	0.053[83]	0.05[78]	0.001[1.1]	1.4
	24 hours	-	0.10[156]	0.02[12.2]	7.8
TSP	Annual	-	60[c]	0.1[a]	< 1
	24 hours	-	150[c]	1.2[a]	< 1
PM_{10}[c]	Annual	50[a]	-	0.1[a]	< 1
	24 hours	150[a]	-	1.2[a]	< 1
Sulfur Dioxide	Annual	0.03[65]	0.02[44]	0.0001[0.23]	< 1
	24 hours	0.14[305]	0.10[218]	0.001[2.7]	1.2
	3 hours	0.50[1,088]	-	0.007[15.1]	1.4
Ozone	Annual	-	-	NA	NA
	1 hour	0.12[196]	-	NA	NA
Hydrogen Sulfide	1 hour	-	0.01[12]	NA	NA
Total Reduced Sulfur	0.5 hour	-	0.03[33]	NA	NA

Sources: 20 NMAC 2.03, 40 CFR Part 50, NMAPCB 1996, SNL/NM 1997d
- indicates no standard for listed averaging time
μg/m³: micrograms per cubic meter
°R: degrees Rankin
ft: feet
NA: Not Available
NAAQS: National Ambient Air Quality Standards
NMAAQS: New Mexico Ambient Air Quality Standards
OLM: ozone limiting method
PM_{10}: Particulate matter less than 10 microns in diameter
ppm: parts per million
TSP: total suspended particulates
[a] μg/m³
[b] The OLM was employed to calculate the nitrogen dioxide component of the nitrogen oxides concentration.
[c] PM_{10} assumed equal to TSP
Note: The standards for some of the pollutants are stated in ppm. These values were converted to μg/m³ with appropriate corrections for temperature (530°R) and pressure (elevation 5,400 ft) following New Mexico Dispersion Modeling Guidelines (NMAPCB 1996).

the table presents the applicable Federal (40 CFR Part 50) and New Mexico state (20 NMAC 2.3) standards for each pollutant.

As shown in Table 5.3.7–1, the maximum concentrations for three criteria pollutants (nitrogen dioxide, TSP, and PM_{10}) were calculated to be within 96 percent of (or 4 percent below) the Federal and state regulatory agency standards for a 24-hour period. These standards, in general, are set to provide for an ample margin of safety below any pollutant concentration that might be of concern.

The methodology used in the criteria pollutant analysis also produces maximum concentration projections that are very conservative. For example, 100 percent of the maximum concentration of air pollutants projected for Cobisa Power Station (located 5 mi west of the National Atomic Museum) was added to the background concentration calculated for the Steam Plant location (near the museum). Also, the maximum concentrations of air pollutants, from a monitoring station measuring contributions from the surrounding community that are dominated by traffic emissions, were added to the worst-case contribution of pollutants from operating SNL/NM's diesel fuel-powered backup generators and fuel oil-powered Steam Plant boilers. Consequently, though close to the thresholds, these calculated concentrations for nitrogen dioxide, TSP, and PM_{10} are considered to be very conservative.

Table 5.3.7–2 presents the modeled incremental criteria pollutant concentrations representing only those new sources expected to become operational by 2008: an "insignificant" boiler and emergency generator in Building 701 and a 600-kw-capacity generator in Building 870b. These new sources are included in the concentrations presented in Table 5.3.7–1 and are presented separately in Table 5.3.7–2 to demonstrate the small incremental increase expected from these sources.

Table 5.3.7–1 presents carbon monoxide concentrations from stationary sources at SNL/NM, while carbon monoxide emissions from mobile (vehicular) sources are presented separately. Monitoring data best represent the combined impact of carbon monoxide emissions from these two sources, and the ambient concentrations of these pollutants are also provided in the table. On June 5, 1998, SNL/NM became subject to a new 8-hour, 0.08-ppm ozone standard, replacing the previous 1-hour, 0.12-ppm ozone standard (63 FR 31034). In the year 2000, the EPA will designate areas that do not meet the 8-hour standard based on the most recently available 3 years of ozone data available at that time (such as 1997 through 1999).

The modeling results presented in Table 5.3.7–1 indicate that the No Action Alternative criteria pollutant concentrations would be below the most stringent standards, which define the pollutant concentrations below which few adverse impacts to human health and the environment are expected. Appendix D contains the assumptions and model input parameters used to calculate the criteria pollutant concentrations presented in Table 5.3.7–1.

Mobile Sources

The model projected carbon monoxide emissions from mobile sources (motor vehicles) from SNL/NM commuter traffic, including on-base vehicles, would be 3,489 tons per year for 2005 (SNL 1996c), which is 598 tons per year below the 1996 baseline. These projections of carbon monoxide emissions are based on estimates of 13,582 vehicles per day entering SNL/NM, a 30 mi-per-day-per-vehicle average commuting distance, and 261 working days per year. The EPA mobile source emission factor model, *MOBILE5a*, was used to project emission factors for the years from 1996 through 2005. The resulting emission factors show a reduction in carbon monoxide emission rates for each successive year. The reduction is based on the model assumption that future vehicles will have inherently lower emission rates and that more stringent inspection and maintenance programs will maintain the lower rates. The trend of lower carbon monoxide emissions projected from SNL/NM would also occur for a similar mix of vehicles operating in the Bernalillo county area due to improvements in vehicle fleet emissions. Projected carbon monoxide emissions for Bernalillo county for 2005 would be 206 tons per day, or 75,190 tons per year (AEHD 1998). The contribution of carbon monoxide emissions from vehicles commuting to and from SNL/NM and from SNL/NM-operated on-base vehicles in 2005, as a percent of the total county highway mobile sources carbon monoxide emissions, would be 4.6 under the No Action Alternative.

Total carbon monoxide emissions are shown in Table 5.3.7–3. Estimates of future construction activities include use of small diesel generators, air compressors, front-end loaders, dozers, and dump trucks. Emissions for the construction activities have been estimated based on exhaust pollutant estimates for diesel construction equipment.

Table 5.3.7–3. Carbon Monoxide Emissions from SNL/NM Under the No Action Alternative (Tons per Year)

STATIONARY SOURCES	MOBILE SOURCES	CONSTRUCTION ACTIVITIES	LURANCE CANYON BURN SITE	TOTAL
18.36[a]	3,489	132	0.78[b]	3,640.14

Sources: SNL/NM 1998a, SNL 1996c

[a] Includes incremental carbon monoxide emissions from an "insignificant" boiler and emergency generator in Building 701 and a 600-kw-capacity generator in Building 870b added between 1996 and 2008.

[b] The number of tests at the Lurance Canyon Burn Site for the No Action Alternative are projected to be equal to those in 1996.

Total carbon monoxide emissions for the No Action Alternative are 598 tons per year less than the 1996 baseline, well below the 100 tons/year incremental increase above baseline that would require a conformity determination. In addition, the total carbon monoxide emissions for the No Action Alternative were found to be approximately 2.7 percent of the maintenance area's emissions of carbon monoxide. As a result, the DOE has concluded that no conformity determination is required for the No Action Alternative.

Lurance Canyon Burn Site

SNL/NM uses the Lurance Canyon Burn Site to test the responses of shipping containers, aerospace components, and other items to high-temperature conditions. Concentrations of pollutants from operations at the fire testing facilities under the No Action Alternative are represented by the emissions from the 42 tests performed during 1996. These tests consumed 10,400 gal of JP-8 aviation fuel and other aviation fuels and 16,050 lb of sawdust (or wood) (SNL/NM 1997a).

The largest of the tests, consuming 1,000 gal of JP-8 fuel, was used to represent the test with the maximum emissions for purposes of modeling. Concentrations of pollutants resulting from test emissions were calculated using the *OBODM* model (Bjorklund et al. 1997). The results for the criteria pollutants are presented in Table 5.3.7–4, along with the applicable Federal (40 CFR Part 50) and New Mexico state (20 NMAC 2.3) standards for each pollutant. Emissions of criteria pollutants resulting from activities at the Lurance Canyon Burn Site are presented in Table 4.9–2.

A total of 89 chemical pollutants resulting from the tests were also evaluated. Each of these pollutants was compared with the respective occupational exposure limit (OEL)/100 guideline, and each of the comparisons indicates that the chemical concentrations are below the guideline. Table D.1–31 in Appendix D contains the list of chemical emissions resulting from tests at the Lurance Canyon Burn Site.

Table 5.3.7–4. Criteria Pollutant Concentrations from the Lurance Canyon Burn Site with Applicable National and New Mexico Ambient Air Quality Standards Under the No Action Alternative

POLLUTANT	AVERAGE TIME	NAAQS (ppm[μg/m^3])	NMAAQS (ppm[μg/m^3])	NO ACTION CONCENTRATION (ppm[μg/m^3])	PERCENT OF STANDARD
Carbon Monoxide	8 hours	9[8,564]	8.7[8,279]	0.023[21.45]	< 1
	1 hour	35[33,305]	13.1[12,466]	0.18[171.6]	1.4
Nitrogen Dioxide	Annual	0.053[83]	0.05[78]	6.4×10^{-7}[0.001]	< 1
	24 hours	-	0.10[156]	1.18×10^{-4}[0.184]	< 1
PM_{10} [a]	Annual	50[b]	-	0.018[b]	< 1
	24 hours	150[b]	-	6.51[b]	4.3
Sulfur Dioxide	Annual	0.03[65]	0.02[44]	4.6×10^{-7}[0.001]	< 1
	24 hours	0.14[305]	0.10[218]	1.7×10^{-4}[0.367]	< 1
	3 hours	0.50[1,088]	-	0.001[2.94]	< 1
TSP	Annual	-	60[b]	0.018[b]	< 1
	24 hours	-	150[b]	6.51[b]	4.3

Sources: 20 NMAC 2.3, 40 CFR Part 50, SNL 1997a
mg/m^3: micrograms per cubic meter
°R: degrees Rankin
ft: feet
NAAQS: National Ambient Air Quality Standards
NMAAQS: New Mexico Ambient Air Quality Standards
PM_{10}: particulate matter less than 10 microns in diameter
ppm: parts per million
TSP: total suspended particulates
[a] PM_{10} assumed equal to TSP
[b] mg/m^3
Note: The standards for some of the pollutants are stated in ppm. These values were converted to mg/m^3 with appropriate corrections for temperature (530° R) and pressure (elevation 5,400 ft) following New Mexico Dispersion Modeling Guidelines (NMAPCB 1996).

Chemical Pollutants

Approximately 465 chemicals, including hazardous air pollutants (HAPs), toxic air pollutants (TAPs), and VOCs, were identified for evaluation from the CIS, CheMaster, and HCPI databases. These chemicals were purchased by the 12 facilities listed in Table 5.3.7–5 during 1996. The table lists all facilities that purchased chemicals at SNL/NM in 1996. Figure 5.3.7–2 shows the locations of these 12 facilities.

Hazardous chemicals purchased during 1996 are categorized into two groups: noncarcinogenic chemicals and carcinogenic chemicals. The list of 465 chemicals purchased during 1996 includes fifteen EPA-confirmed carcinogenic chemicals that were purchased by 5 facilities. The remaining chemicals are categorized as noncarcinogenic chemicals. Each group is evaluated using a screening technique based on 1/100 of the relevant OEL for noncarcinogens or 1/100 of the relevant unit risk factor for carcinogens in order to identify those chemicals of potential concern.

Noncarcinogenic Chemical Screening

Noncarcinogenic chemicals that could cause air quality impacts at SNL/NM are identified through a progressive series of screening steps detailed in Appendix D in which each successive step reduces the number of pollutants to only those chemicals that have a reasonable chance of being chemicals of concern.

Occupational Exposure Limit (OEL)

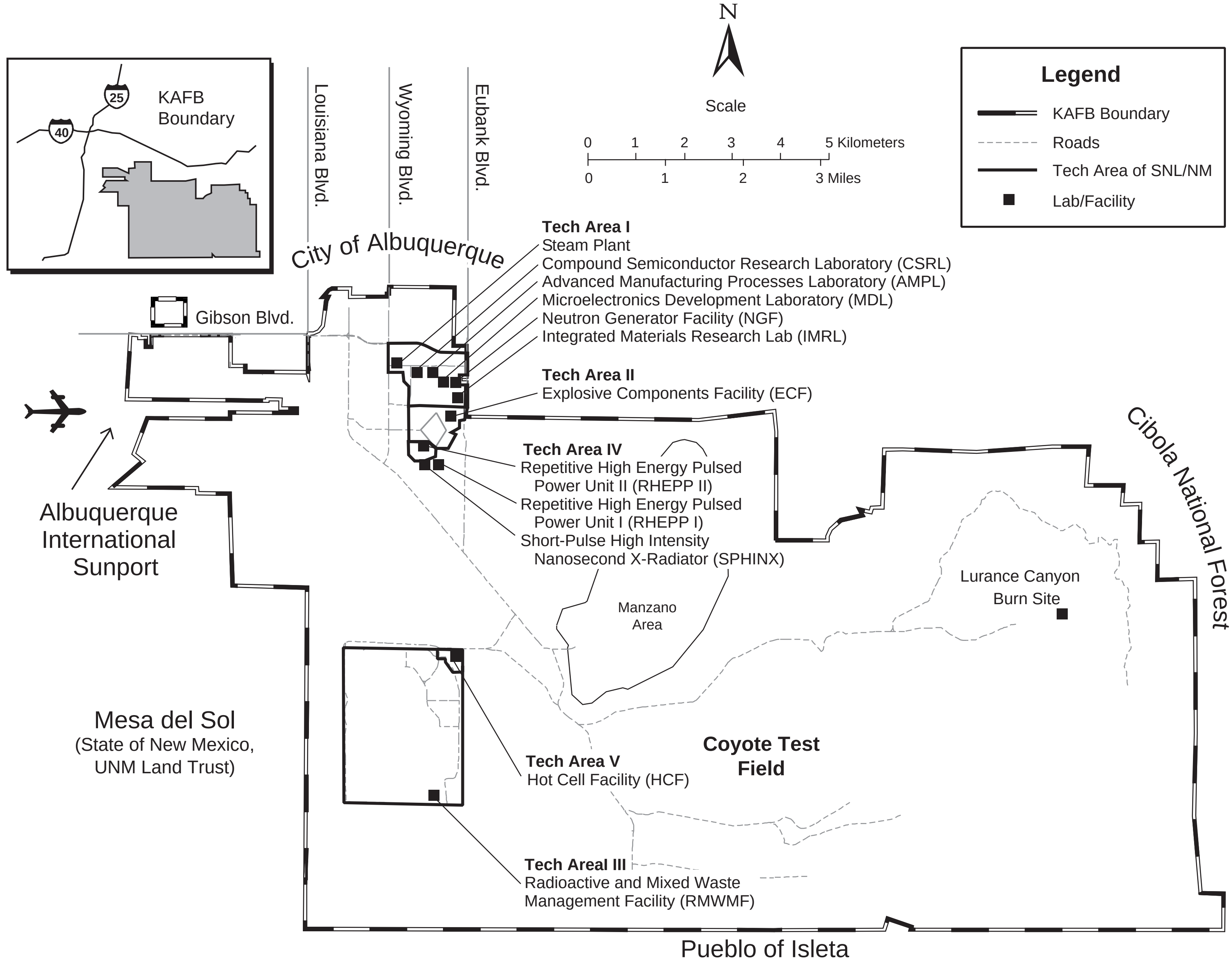
The occupational exposure limit is a time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect. The minimum OEL obtained from four reference sources divided by a safety factor of 100 is used as the screening guideline to determine chemicals of concern (COCs).

Only 30 noncarcinogenic chemicals from 5 facilities exceed the screening level based upon emission rates calculated from purchases. Only 1 of the 30 noncarcinogenic chemicals exceeded the screening level based upon facility-estimated emission rates. The human health impacts from this chemical, chromium trioxide (Building 870), are presented in Section 5.3.8. The results of the screening analysis are presented in detail in Appendix D.

Table 5.3.7–5. SNL/NM Facilities from which Chemical Emissions were Modeled

TECHNICAL AREA	BUILDING NUMBER	FACILITY NAME
I	605	Steam plant
I	858	Microelectronics Development Laboratory (MDL)
I	870	Neutron Generator Facility (NGF)
I	878	Advanced Manufacturing Processes Laboratory (AMPL)
I	893	Compound Semiconductor Research Laboratory (CSRL)
I	897	Integrated Materials Research Laboratory (IMRL)
II	905	Explosive Components Facility (ECF)
III	6920	Radioactive and Mixed Waste Management Facility (RMWMF)
IV	963	Repetitive High Energy Pulsed Power Unit II (RHEPP II)
IV	981	Short-Pulse High Intensity Nanosecond X-Radiator (SPHINX)
IV	986	Repetitive High Energy Pulsed Power Unit I (RHEPP I)
V	6580	Hot Cell Facility (HCF)

Source: SNL/NM 1998a



Source: SNL/NM 1997a

Figure 5.3.7–2. Major Chemical-Emitting Facilities at SNL/NM

Twelve SNL/NM facilities emit the majority of chemicals.

Carcinogenic Chemical Screening

Table 5.3.7–6 presents those carcinogenic chemicals with estimated emission rates greater than the screening level. Human health impacts from these 10 carcinogenic chemicals are presented in Section 5.3.8.

Summary of Nonradiological Air Quality Impacts

Under the No Action Alternative, nonradiological air quality concentrations for criteria and chemical pollutants are below regulatory standards and human health guidelines. Maximum concentrations of criteria pollutants from operation of the steam plant, electric power generator plant, boiler and emergency generator in Building 701, and 600-kw-capacity generator in Building 870b represent a maximum of 96 percent of the allowable regulatory limit at a public access area. Thirty noncarcinogenic chemicals exceed the screening levels based upon emission rates calculated from purchased quantities, but only one noncarcinogenic chemical exceeds the screening levels based upon process engineering estimates of actual emission rates. Further analysis of this one noncarcinogenic chemical is performed in Section 5.3.8. The risks due to exposure of the 10 carcinogenic chemicals that exceeded the screening levels are evaluated in Section 5.3.8, Human Health and Worker Safety.

Unit Risk Factor

The unit risk factor is a dose response parameter used to identify lifetime carcinogenic health effects relative to the level of chemical exposure (risk per unit concentration). The unit risk factor multiplied by the exposure concentration equals the excess lifetime cancer risk. The carcinogenic chemical guideline used to screen the carcinogenic chemicals represents a lifetime cancer risk of 1.0×10^{-8}. It is calculated by dividing 1.0×10^{-8} risk by the chemical-specific unit risk factor. This results in a chemical concentration below which no health effect is expected.

5.3.7.2 Radiological Air Quality

The SWEIS analysis reviewed the radiological emissions from all SNL/NM facilities. Section 4.9.2 identifies 17 SNL/NM facilities as producing radiological emissions. Based on historic SNL/NM radionuclide emissions data, NESHAP (40 CFR Part 61), compliance reports, and the *SNL/NM Facilities and Safety Information Documents* (FSID) (SNL/NM 1998ee), 10 of the 17 SNL/NM

Table 5.3.7–6. Annual Carcinogenic Chemical Concentrations from Facility Emissions Under the No Action Alternative

CHEMICALS EXCEEDING SCREENING LEVELS	BUILDING SOURCE	NO ACTION CONCENTRATION (ppb/μg/m^3)
Chloroform (Trichloromethane)	6580	1.45×10^{-3}[5.89×10^{-3}]
Dichloromethane (Methylene chloride)	870	7.31×10^{-2}[2.11×10^{-1}]
Dichloromethane (Methylene chloride)	878	2.66×10^{-3}[7.67×10^{-3}]
Formaldehyde	878	4.77×10^{-4}[4.87×10^{-4}]
Trichloroethene	878	8.74×10^{-3}[3.90×10^{-2}]
1,2-Dichloroethane (Ethylene dichloride)	893	2.93×10^{-4}[9.85×10^{-4}]
1,4-Dichloro-2-butene	897	3.96×10^{-5}[1.68×10^{-4}]
Acrylonitrile	897	1.52×10^{-4}[2.74×10^{-4}]
Chloroform (Trichloromethane)	897	1.25×10^{-3}[5.07×10^{-3}]
Trichloroethene	897	1.58×10^{-3}[7.06×10^{-3}]

Source: SNL/NM 1998a
mg/m^3: micrograms per cubic meter
ppb: parts per billion
Bldg. 6580 – Hot Cell Facility (HCF)
Bldg. 870 – Neutron Generator Facility
Bldg. 878 – Advanced Manufacturing Processes Laboratory (AMPL)
Bldg. 893 – Compound Semiconductor Research Laboratory (CSRL)
Bldg. 897 – Integrated Materials Research Laboratory (IMRL)

facilities were modeled for radiological impacts (Table 5.3.7–7). The ACRR would be operated under one of two configurations: medical isotopes production (primarily molybdenum-99 production) or DP. However, for the purpose of conservative analysis, the ACRR was evaluated under simultaneous operation of both configurations. Based on the review of historical dose evaluations, facilities other than these 10 would not contribute more than 0.01 mrem/yr (0.1 percent of the NESHAP limit) to the MEI and were screened from further consideration in the SWEIS. The modeled releases to the environment would result in a calculated dose to the MEI and the population within 50 mi of TA-V. TA-V was selected as a center for the population within a 50-mi radius, because the majority of radiological emissions would be from TA-V, specifically the HCF, and TA-V is historically addressed for annual SNL/NM NESHAP compliance (SNL/NM 1996u). The *CAP88-PC* computer model (DOE 1997e) was used to calculate the doses. Details on the *CAP88-PC* model, radionuclide emissions, model and source parameters, exposures, meteorological data, and population data are presented in Appendix D. Figure 5.3.7–3 shows the locations of the 10 facilities modeled in the SWEIS. Table 5.3.7–7 presents the estimated radiological emissions from the 10 SNL/NM facilities under the No Action Alternative. The radiological emissions from each facility were estimated based on SNL/NM planned operations and tests projected into the future. Detailed information is available in the FSID (SNL/NM 1998ee). The emission of argon-41 from the ACRR, under the medical isotope production configuration, would be lower than during the base year, 1996, because of the refurbishing operations conducted during 1996. The SPR emissions were estimated to be higher than the base year. This was due to instituting NESHAP requirements for “confirmatory measurements” of radiological air emissions where measured emission factors were determined for both the SPR and the ACRR. These measured emission factors were found to be higher than the calculated emission factors. These measurements are source-specific to the SPR and ACRR and would not affect the calculations or measurements for other facilities.

Because the general public and USAF personnel have access to SNL/NM, 14 core receptor locations and 2 offsite receptor locations of public concern were considered for dose impacts evaluations (see Appendix D.2). Based on NESHAP reports, 16 onsite and 6 offsite additional receptor locations were also evaluated. A total of 38 receptor locations were evaluated for dose impacts. The core receptor locations include schools, hospitals, a museum, and clubs, and were considered for analysis because of potential impacts to children, the sick, and the elderly. The 32 modeled onsite and core receptor locations and locations of public concern are shown in Figure 5.3.7–4.

The dose to an individual at each receptor location and to the population within 50 mi from the radionuclide emissions from each source was calculated using the *CAP88-PC* model. The public receptor receiving the maximum reported dose is identified as the MEI. The model-calculated dose contributions, including external, inhalation, and ingestion exposure pathways from each of the 10 sources, calculated individually at each receptor location, were combined to determine the overall SNL/NM site-wide normal operations dose to the MEI. Under the No Action Alternative, the maximum effective dose equivalent (EDE) to the MEI from all exposure pathways from all modeled sources was calculated to be 0.15 mrem/yr. The MEI is located at the Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC), north of TA-V. This location is consistent with the location of the MEI historically identified in the annual NESHAP compliance reports. The EDE contributions from these 10 sources to this highest combined MEI dose are presented in Table 5.3.7–8. Table 5.3.7–9 presents the doses to 38 onsite, core, and offsite receptor locations. The potential doses for these additional locations would be much lower than the MEI dose. Under the No Action Alternative, the total collective dose to the population of 732,523 within a 50-mi radius of TA-V was calculated to be 5.0 person-rem per year. Section 5.3.8 discusses the human health impacts of radiological emissions at SNL/NM. The contributions from the 10 modeled sources to the overall SNL/NM site-wide normal operations collective dose to the population within 50 mi are also presented in Table 5.3.7–8. The average dose to an individual (collective dose divided by the total population) in the population within 50 mi of TA-V would be $6.8x10^{-3}$ mrem/yr.

The calculated total MEI dose of 0.15 mrem/yr would be much lower than the regulatory limit of 10 mrem/yr to an MEI from SNL/NM site-wide total airborne releases of radiological materials (40 CFR Part 61). This dose is small compared to an individual background radiation dose of 360 mrem/yr (see Figure 4.10–2). The calculated collective dose from SNL/NM operations to the population within 50 mi of TA-V, 5.0 person-rem per

Table 5.3.7–7. Radiological Emissions from Sources at SNL/NM Under the No Action Alternative

FACILITY NAME	TECHNICAL AREA	RADIONUCLIDE[a]	RELEASE (Ci/yr)
Annular Core Research Reactor (ACRR) (DP configuration), Building 6588	V	Argon-41	2.6
Annular Core Research Reactor (ACRR) (medical isotopes production configuration), Building 6588	V	Argon-41 Tritium	1.1 1.1
Explosive Components Facility (ECF), Building 905	II	Tritium	2.0×10^{-3}
High-Energy Radiation Megavolt Electron Source (HERMES III), Building 970	IV	Nitrogen-13 Oxygen-15	1.245×10^{-3} 1.245×10^{-4}
Hot Cell Facility (HCF), Building 6580	V	Iodine-131 Iodine-132 Iodine-133 Iodine-134 Iodine-135 Krypton-83m Krypton-85 Krypton-85m Krypton-87 Krypton-88 Xenon-131m Xenon-133 Xenon-133m Xenon-135 Xenon-135m	1.17 3.0 5.4 0.22 3.3 198.0 0.19 290.0 57.0 480.0 1.8 2,160.0 102.0 2,070.0 360.0
Mixed Waste Landfill (MWL)	III	Tritium	0.29
Neutron Generator Facility (NGF), Building 870	I	Tritium	156.0
Radioactive and Mixed Waste Management Facility (RMWMF), Building 6920	III	Tritium	2.203[b]
Radiographic Integrated Test Stand (RITS), Building 970	IV	Nitrogen-13	0.12
Sandia Pulsed Reactor (SPR), Building 6590	V	Argon-41	9.5

Source: SNL/NM 1998a
Ci/yr: curies per year
DP: Defense Programs
SNL/CA: Sandia National Laboratories/California

[a] Radiological emissions are projections based on planned activities, projects, and programs. Radionuclide releases are not the same as those presented in Chapter 4.
[b] Because SNL/CA tritium-contaminated oil levels handled at the RMWMF during the base year were abnormally high, this maximum level of emissions was assumed to be released in any year and, therefore, was constant for all alternatives.

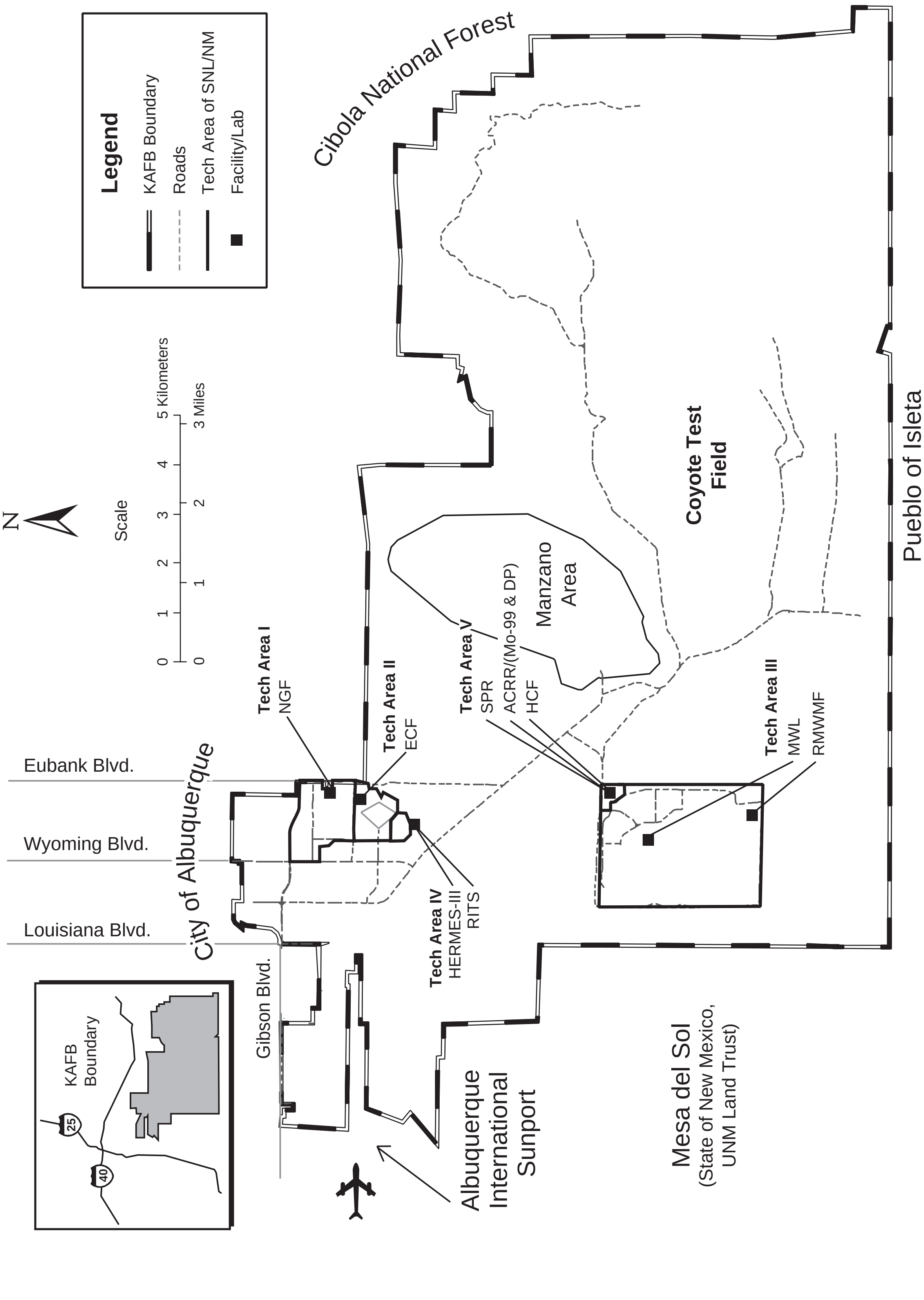


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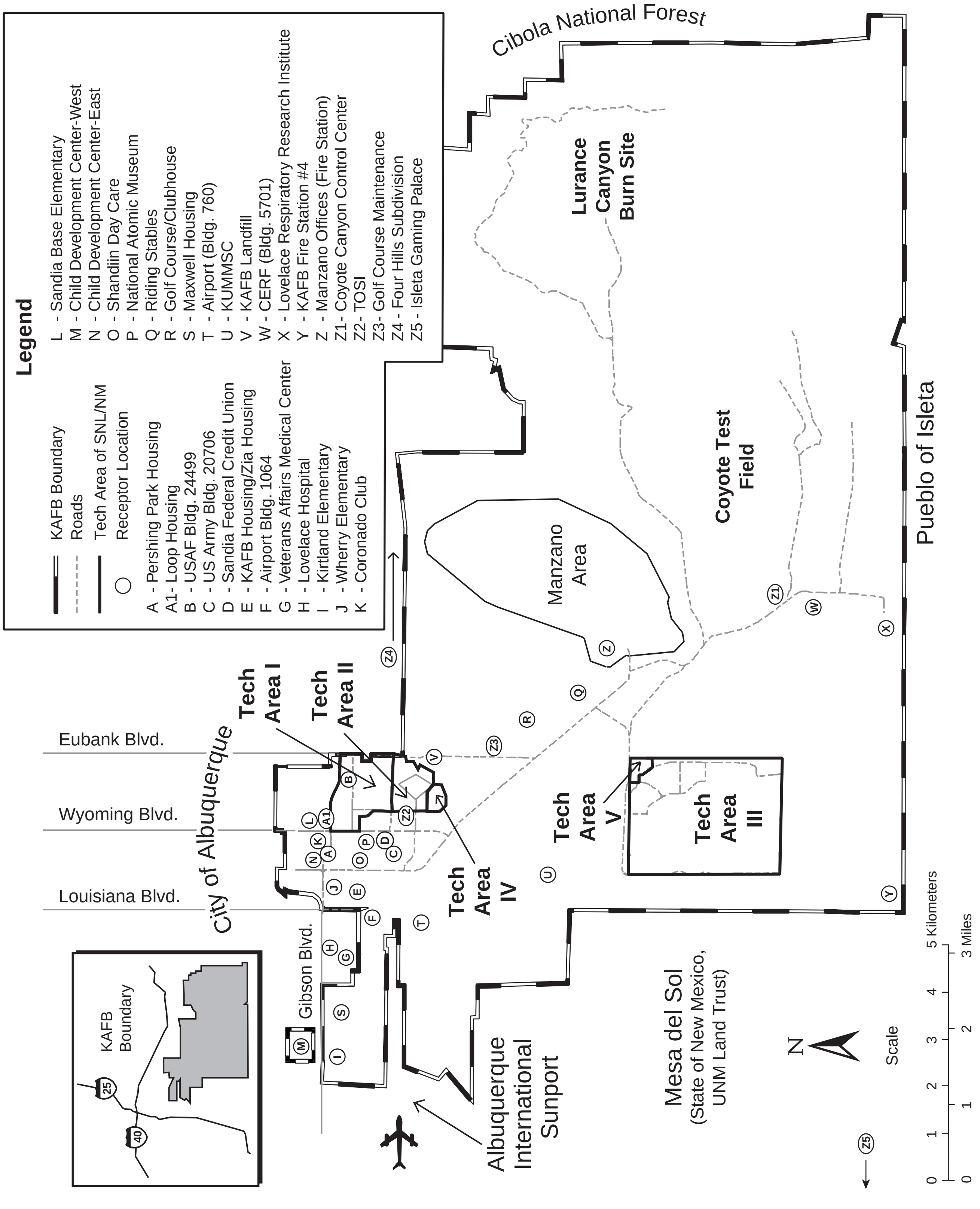
Figure 5.3.7–3. Locations of Radionuclide-Releasing Facilities at SNL/NM

The 10 SNL/NM facilities that release radionuclides are in 5 technical areas.



Source: SNL/NM 1996u

Figure 5.3.7–4. Normal Operational Onsite and Core Receptor Locations

Thirty-two onsite and core receptor locations were evaluated for potential normal operation impacts.

Table 5.3.7–8. Summary of Dose Estimates from Radioactive Air Emissions to the SNL/NM Public Under the No Action Alternative

SOURCE	ANNUAL MEI DOSE, EDE (mrem)	ANNUAL POPULATION DOSE, PERSON-REM
Annular Core Research Reactor (ACRR) (DP configuration)	4.2×10^{-4}	7.2×10^{-3}
Annular Core Research Reactor (ACRR) (medical isotopes production configuration)	2.1×10^{-4}	5.36×10^{-3}
Explosive Components Facility (ECF)	9.9×10^{-9}	4.19×10^{-6}
High-Energy Radiation Megavolt Electron Source (HERMES III)	1.0×10^{-8}	2.1×10^{-7}
Hot Cell Facility (HCF)	1.5×10^{-1}	4.61
Mixed Waste Landfill (MWL)	4.0×10^{-6}	6.16×10^{-4}
Neutron Generator Facility (NGF)	7.4×10^{-4}	3.22×10^{-1}
Radioactive and Mixed Waste Management Facility (RMWMF)	7.5×10^{-6}	3.24×10^{-3}
Radiographic Integrated Test Stand (RITS)	9.8×10^{-7}	4.5×10^{-7}
Sandia Pulsed Reactor (SPR)	1.3×10^{-3}	2.54×10^{-2}
TOTAL MEI DOSE	**0.15**	**-**
50-MILE POPULATION COLLECTIVE DOSE	**-**	**5.0**

Sources: DOE 1997e, SNL/NM 1998a
DP: Defense Programs
EDE: effective dose equivalent
MEI: maximally exposed individual
mrem: millirem

Note: Although the Annular Core Research Reactor is expected to be operated under DP configuration intermittently, for this analysis it was assumed to be operated simultaneously with the medical isotopes production configuration. Its contribution to the total dose is not appreciable.

Table 5.3.7–9. Summary of Dose Estimates from Radioactive Air Emissions to 38 Onsite and Offsite Receptors Under the No Action Alternative

RECEPTOR	ANNUAL RECEPTOR DOSE, EDE (mrem)
ONSITE AND NEAR-SITE RECEPTORS	
Albuquerque International Sunport (Bldg. 1064)	1.8×10^{-2}
Albuquerque International Sunport (Bldg. 760)	3.9×10^{-2}
Building 20706	2.8×10^{-2}
Building 24499	2.0×10^{-2}
Child Development Center-East	1.8×10^{-2}
Child Development Center-West	1.9×10^{-2}
Civil Engineering Research Facility (Bldg. 5701)	1.2×10^{-2}
Coronado Club	2.0×10^{-2}
Coyote Canyon Control Center	1.2×10^{-2}
Golf Course Clubhouse	7.2×10^{-2}

Table 5.3.7–9. Summary of Dose Estimates from Radioactive Air Emissions to 38 Onsite and Offsite Receptors Under the No Action Alternative (concluded)

RECEPTOR	ANNUAL RECEPTOR DOSE, EDE (mrem)
Golf Course Maintenance Area	4.5×10^{-2}
Kirtland Elementary School	1.9×10^{-2}
KAFB Firestation #4 (Bldg. 9002)	1.7×10^{-2}
KAFB Landfill	2.9×10^{-2}
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	1.5×10^{-1}
Loop Housing	2.1×10^{-2}
Lovelace Hospital	1.4×10^{-2}
Lovelace Respiratory Research Institute	1.2×10^{-2}
Manzano Offices (Fire Station)	3.4×10^{-2}
Maxwell Housing	2.2×10^{-2}
National Atomic Museum	2.5×10^{-2}
Pershing Park Housing	1.7×10^{-2}
Riding Stables	6.3×10^{-2}
Sandia Base Elementary	1.7×10^{-2}
Sandia Federal Credit Union	3.1×10^{-2}
Shandiin Day Care Center	2.2×10^{-2}
Technical Onsite Inspection Facility	3.3×10^{-2}
Veterans Affairs Medical Center	2.7×10^{-2}
Wherry Elementary School	1.8×10^{-2}
Zia Park Housing	2.4×10^{-2}
OFFSITE RECEPTORS	
Albuquerque City Offices	5.1×10^{-2}
East Resident	2.4×10^{-2}
Eubank Gate Area (Bldg. 8895)	4.5×10^{-2}
Four Hills Subdivision	4.1×10^{-2}
Isleta Gaming Palace	2.7×10^{-2}
Northeast Resident	3.0×10^{-2}
Seismic Center (USGS)	2.7×10^{-2}
Tijeras Arroyo (West)	6.3×10^{-2}

Sources: DOE 1997e, SNL/NM 1998a
EDE: effective dose equivalent
MEI: maximally exposed individual
mrem: millirem
USGS: U.S. Geological Survey

year, is much lower than the collective dose to the population from background radiation. Based on the individual background radiation dose, the population within 50 mi of TA-V would receive 263,700 person-rem per year.

5.3.8 Human Health and Worker Safety

The implementation of the No Action Alternative could result in impacts to public health and worker health and safety from both normal facility operations and postulated accident scenarios. The impacts would be the result of radiological and nonradiological releases from SNL/NM operations. The following sections describe these impacts.

A receptor is any individual who could be affected by SNL/NM operations. Health risk assessments for receptors at specific locations in the immediate SNL/NM vicinity were used to characterize the health risks for all possible receptors.

Fourteen core receptor locations were consistent among the evaluations for impacts due to routine operations, chemical and radiological emissions, and potential facility accidents at SNL/NM. These receptor locations were selected based on a review of historic NESHAP compliance reports, which discuss the location of the MEI member of public and take into consideration that the general public and Air Force personnel have access to SNL/NM. Other factors taken into account include information contained in the *SNL/NM Facility Source Documents* (SNL/NM 1998a), receptor locations in close proximity to the sources, the nearest site boundary in the prevailing wind directions, and the presence of potentially sensitive receptors such as children, the sick, and the elderly. These 14 receptor locations are listed below.

- Child Development Center-East
- Child Development Center-West
- Coronado Club
- Golf Course (Clubhouse)
- Kirtland Elementary School
- KAFB Housing (Zia Housing)
- KUMMSC
- Lovelace Hospital
- National Atomic Museum
- Riding Stables
- Sandia Base Elementary School
- Shandiin Day Care Center
- Veterans Affairs Medical Center (Hospital)
- Wherry Elementary School

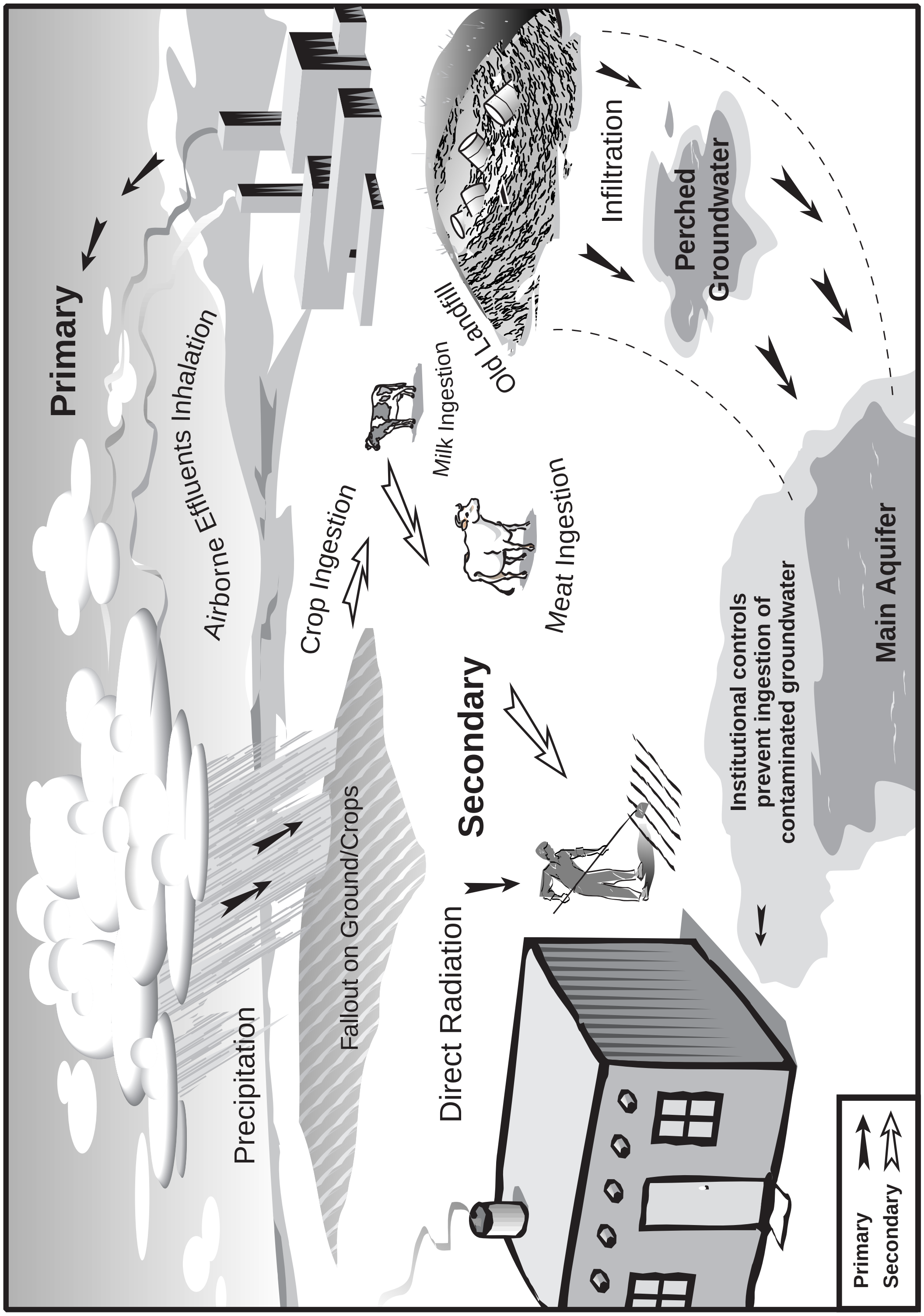
In addition to these 14 core receptor locations, 2 locations of public concern, the Four Hills Subdivision and the Isleta Gaming Palace, were also evaluated for human health. The specific evaluations of chemical air emissions, radiological air emissions, and facility accidents also included additional receptor locations unique to the needs of the resource area, in order to complete their analyses of impacts (see discussions in radiological air, chemical air, and accident analyses).

5.3.8.1 Normal Operations

This section provides information on public health and worker health and safety under the No Action Alternative. It assesses the potential human health impacts associated with releases of radioactive and nonradioactive hazardous material from SNL/NM normal operations. Human health risk analyses identify potential health effects to all possible receptors, such as SNL/NM employees, contractors, visitors, and members of the public within and outside the KAFB boundary. For detailed discussions of analytical methods and results, along with terminology, definitions, and descriptions, see Appendix E.

Radiological and nonradiological hazardous material released by SNL/NM during normal operations reach the environment and potentially reach people in different ways (Figure 5.3.8–1). See specific sections in Chapter 5 on geology and soils, water, and air quality for a description of SNL/NM's impacts to the different environmental media. These sections discuss historic results from environmental sampling programs and predictive modeling of future conditions. They also present quantitative and qualitative assessments of the potential exposure pathways associated with these media. The air pathway is the primary exposure pathway identified in the SWEIS that has the potential to carry materials directly from SNL/NM facilities to the environment and then to people who are exposed directly by way of inhalation. Secondary air exposure pathways exist from the indirect ingestion of pollutants by way of foods, including crops contaminated by airborne pollutants and livestock products from animals ingesting contaminated crops.

Other pathways investigated include groundwater, surface water, and soils. The potential primary exposure pathway of directly ingesting contaminated water was investigated,



Source: Original

Figure 5.3.8–1. Primary and Secondary Complete Exposure Pathways Associated with SNL/NM Normal Operations

Radiological and nonradiological hazardous material released by SNL/NM operations have the potential to reach people through different exposure pathways.

but the determination was made that the area of polluted groundwater beneath SNL/NM would not migrate to areas planned or currently in use for the drinking water supply (see Appendix B). People would not be exposed through ingesting surface water because SNL/NM normal operations would not affect surface water resources (see Sections 5.3.4, 5.4.4, and 5.5.4). Affected soils at SNL/NM would be controlled under the ER Project. Potential routine (nonremedial) releases of contaminated soils or dust are controlled on a site-specific basis, thus preventing potential exposures by way of inhalation or ingestion (DOE 1996c).

The different health risks identified for specific receptor locations, individual exposure scenarios, and the potential maximum exposures adequately characterize health risks from SNL/NM normal operations.

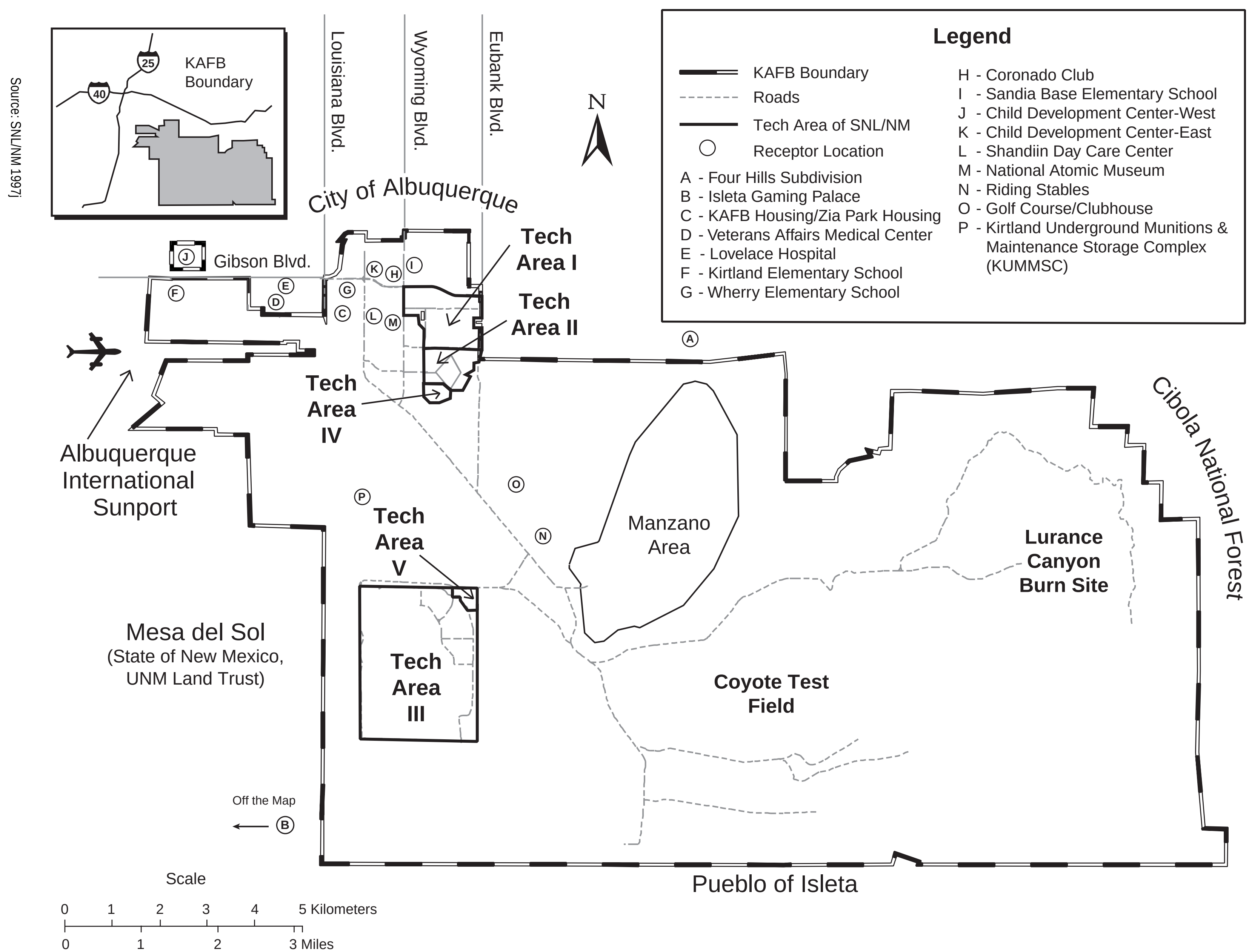
Health risk analyses are presented for potential exposures at each specific receptor location and for the maximum potential exposures to radiation and chemical air releases. Figure 5.3.8–2 shows the core- and public concern-receptor locations selected for health risk analyses. The maximum potential exposure to radiation is known to likely occur within KAFB at the KUMMSC, based on analysis of years of data collected to meet NESHAP requirements. Health risk at the KUMMSC receptor location, therefore, represents the maximum potential health risk from radiation and is referred to as the MEI for normal operations. A location where the maximum potential exposure to chemical air releases could occur was not identified because of limited historical chemical air emissions information. Instead, a bounding value for health risk from chemical air emissions was calculated based on a hypothetical worst-case exposure scenario. The hypothetical worst-case exposure scenario assumed simultaneous exposure to the estimated maximum offsite concentration of each chemical. Because these estimated concentrations are expected to occur at different locations, this exposure level would be implausible. The actual potential maximum exposure to chemical air emissions and the associated health risks are identified as "less than" this upper-bound health risk value.

A range of health risks was used to evaluate the possibility of adverse health impacts due to SNL/NM normal operations. Health risks depend on a person actually coming in contact with hazardous material released into the environment. Receptor location, estimated time of exposure to the material, and age of the receptor are among the parameters used to establish exposure scenarios. In the case of transport by way of the air pathway, exposure also varies with wind direction and distance from the source. This equates to variability in potential health risks.

Chemical Air Release Pathways

Air releases of hazardous chemicals from laboratories and other chemical operations at SNL/NM are reported in compliance with *Superfund Amendments Reauthorization Act* (SARA) Title III requirements. Actual monitoring of emissions from each potential building source is not required. Estimates of total pounds emitted of HAPs, TAPs, and VOCs were based on the conservative assumption that the entire purchased amounts of chemicals would be released. For purposes of assessing routine exposures to chemical releases from SNL/NM normal operations, potential emissions were first estimated and then evaluated against screening TEVs that are based on the OELs/100 for noncarcinogens, and a 10^{-8} cancer risk for carcinogens (see Appendix D). Only those chemical sources (buildings and amounts) exceeding the screening TEVs could be expected to result in potential exposures to receptors in the SNL/NM vicinity. Air exposure concentrations were estimated and used to evaluate potential health risk. Concentrations of chemicals having toxicity dose-response information become the basis for calculating the hazard index (HI) and excess lifetime cancer risk (ELCR) values under different exposure scenarios. This chemical assessment process identified seven individual chemicals of concern (COCs) (three chemicals are common) under the No Action Alternative (see Appendix E, Table E.3–2). These COCs are associated with SNL/NM's operations in Buildings 878 (Advanced Manufacturing Processes Laboratory [AMPL]), 893 (Compound Semiconductor Research Laboratory [CSRL]), 897 (Integrated Materials Research Laboratory [IMRL]), 6580 (HCF), and 870 (NGF).

The potential for human contact with airborne chemicals would vary with time and distance from the SNL/NM building source. The health risk and corresponding potential for adverse health effects is a range of values. Several receptor locations, individual exposure scenarios, and a hypothetical worst-case exposure scenario were used to present the range of health risks from airborne chemicals in the SNL/NM vicinity. Adult and child and residential and visitor risk assessments were calculated. The health risk values presented are the total risk to a receptor due to chronic exposure to all COCs.



Source: SNL/NM 1997i

Figure 5.3.8–2. Receptor Locations in the SNL/NM Vicinity Assessed for Human Health Impacts

Specific receptor locations in the SNL/NM vicinity are used to assess human health risk from SNL/NM normal operations.

Measures of Nonradiological Health Risks

Chemicals of concern are categorized by health effect. Exposure to some chemicals can cause cancer, while others have a noncarcinogenic health effect, such as damage to a specific organ of the body (target organ). Other chemicals have the potential to induce both carcinogenic and noncarcinogenic health effects.

The risk of a noncarcinogenic health effect occurring is expressed as a Hazard Index (HI). Hazard quotients are derived for different chemicals from the ratio of the estimated exposure level to the reference exposure level expected not to cause a health effect, and then summed to get a Total HI. The hazard quotient assumes that there is a level of exposure (reference exposure) below which it is unlikely for even sensitive populations to experience adverse health effects. If the Total HI is less than 1, health effects are not expected. If an HI exceeds 1, there may be concern for potential health effects; however, it should not be interpreted as a probability for actually occurring. The level of concern does not increase linearly with HIs above 1 (EPA 1989).

Excess Lifetime Cancer Risk (ELCR) is the increased chance of getting cancer in addition to all other causes or susceptibilities in a person's life. For example, if exposures to air emissions of a specific chemical equate to a ELCR of 10^{-7}, a person has an additional 1-in-10 million lifetime chance of getting cancer from that exposure. ELCR is the product of the estimated exposure level and the chemical-specific cancer slope factor that represents the health effect per unit intake over a lifetime. ELCR values for different chemicals are summed to obtain the Total ELCR.

Under the Superfund Program, the EPA has established a 10^{-6} ELCR (1 in 1 million persons) as the "point of departure for establishing remediation goals." It expresses EPA's preference for setting clean-up levels at the more protective end of the risk range (10^{-4} to 10^{-6}). Setting an "acceptable" risk level becomes a site-specific decision based on long-term use of the site (40 CFR Part 300). The background 1997 estimated fatal cancer rate in New Mexico is 146 per 100,000 persons (ACS 1997).

The calculation of HIs and ELCRs takes into account potentially sensitive subpopulations. To take into account differences among individuals, such as breathing rate or body weight within the potentially exposed population, the EPA recommends doing both a "reasonable maximum" exposed (RME) and an "average" exposed individual (AEI) risk assessment (EPA 1989). The assessment of the RME uses upper bound (90th percentile) intake parameters to describe the individual. The assessment of the AEI uses central tendency (50th percentile) intake parameters to describe the individual (see Appendix E, Table E.5–1). The risks to the AEI are applicable to the general population, while risks to the RME are applicable to individuals within the population with a greater potential intake under the same exposure scenario.

Potential exposures (exposure point concentrations) to chemical air releases at specific receptor locations in the SNL/NM vicinity were estimated for normal SNL/NM operations and are shown in Appendix E, Table E.3–2. The potential health risks at these specific receptor locations due to the estimated exposure levels are shown in Table 5.3.8–1. These potential health risks would be very low and no adverse health effects would be expected at these risk levels. In addition, the assessment of the hypothetical worst-case exposure scenario bounds (sets an upper value to) the analysis of health risk. The estimated upper bound values for health risk from noncarcinogenic chemical releases under the No Action Alternative are HIs of less than 1, and from carcinogenic chemicals, are ELCR values of less than 10^{-6} (see Appendix E, Table E.6–3).

Radiation Air Release Pathways

Air releases of radionuclides from SNL/NM operations would result in low radiation exposures to people in the SNL/NM vicinity. Table 5.3.7–8 identifies the radiation dose to the potential MEI and the collective radiation dose to the population within the ROI, associated with these releases. The risk estimator of 500 fatal cancers per 1 M person-rem to the public converts radiation dose to latent fatal cancer risk. The potential maximum annual exposure to radiation from SNL/NM radiological facilities of 0.15 mrem would occur within the site boundary at the KUMMSC and increase the MEI lifetime risk of fatal cancer by 7.5×10^{-8} (see Table 5.3.8–2). In other words, the likelihood of the MEI developing fatal cancer from a 1-year dose from SNL/NM operations is less than 1 chance in 10 M. The annual collective dose of 5.0 person-rem to the

Table 5.3.8–1. Human Health Impacts in the Vicinity of SNL/NM from Chemical Air Emissions Under the No Action Alternative

RECEPTOR LOCATIONS	RECEPTOR	TOTAL HAZARD INDEX RME/AEI	TOTAL EXCESS LIFETIME CANCER RISK RME/AEI
RESIDENTIAL SCENARIOS			
Four Hills Subdivision[a]	Adult	<0.01/<0.01	$3.7x10^{-11}/2.3x10^{-11}$
	Child	<0.01/<0.01	$1.5x10^{-11}/1.5x10^{-11}$
Isleta Gaming Palace	Adult	<0.01/<0.01	$1.6x10^{-9}/1.7x10^{-11}$
	Child	<0.01/<0.01	$1.1x10^{-9}/1.3x10^{-11}$
KAFB Housing (Zia Park Housing)	Adult	<0.01/<0.01	$6.7x10^{-10}/7.0x10^{-12}$
	Child	<0.01/<0.01	$4.7x10^{-10}/5.3x10^{-12}$
VISITOR SCENARIOS			
Child Development Center-East	Child	<0.01/<0.01	$6.1x10^{-10}/6.9x10^{-12}$
Child Development Center-West	Child	<0.01/<0.01	$1.2x10^{-10}/1.4x10^{-12}$
Coronado Club	Adult	<0.01/<0.01	$1.1x10^{-9}/1.1x10^{-11}$
	Child	<0.01/<0.01	$7.4x10^{-10}/8.4x10^{-12}$
Golf Course (Clubhouse)	Adult	<0.01/<0.01	$3.8x10^{-10}/3.9x10^{-12}$
Kirtland Elementary School	Child	<0.01/<0.01	$1.0x10^{-10}/1.1x10^{-12}$
Kirtland Underground Munitions & Maintenance Storage Complex (KUMMSC)[b]	Adult	<0.01/<0.01	$3.8x10^{-10}/4.0x10^{-12}$
Lovelace Hospital	Adult	<0.01/<0.01	$3.0x10^{-10}/3.1x10^{-12}$
	Child	<0.01/<0.01	$2.1x10^{-10}/2.3x10^{-12}$
National Atomic Museum	Adult	<0.01/<0.01	$1.8x10^{-9}/1.9x10^{-11}$
	Child	<0.01/<0.01	$1.3x10^{-9}/1.4x10^{-11}$
Riding Stables	Adult	<0.01/<0.01	$3.0x10^{-10}/3.0x10^{-12}$
Sandia Base Elementary School	Child	<0.01/<0.01	$8.2x10^{-10}/9.3x10^{-12}$
Shandiin Day Care Center	Child	<0.01/<0.01	$6.9x10^{-10}/7.8x10^{-12}$
Veterans Affairs Medical Center	Adult	<0.01/<0.01	$2.9x10^{-10}/3.0x10^{-12}$
Wherry Elementary School	Child	<0.01/<0.01	$4.6x10^{-10}/5.2x10^{-12}$

Source: SmartRISK 1996
RME: reasonable maximum exposed
AEI: average exposed individual
[a] Four Hills Subdivision receptor location impacts are based on Lurance Canyon Burn Site open burning air emissions, not SNL/NM building air emissions.
[b] This receptor location was analyzed using a worker scenario, as discussed in Appendix E.5.
Notes: Calculations were completed using SmartRISK. See the beginning of Section 5.3.8 for a discussion of selection of receptor locations.

Table 5.3.8–2. Human Health Impacts in the SNL/NM Vicinity from Radiological Air Emissions Under the No Action Alternative

RECEPTOR LOCATIONS	LIFETIME RISK OF FATAL CANCER FROM A 1-YEAR DOSE
Child Development Center-East	$9.0x10^{-9}$
Child Development Center-West	$9.5x10^{-9}$
Coronado Club	$1.0x10^{-8}$
Four Hills Subdivision	$2.1x10^{-8}$
Golf Course (Clubhouse)	$3.6x10^{-8}$
Kirtland Elementary School	$9.5x10^{-9}$
KAFB Housing (Zia Park Housing)	$1.1x10^{-8}$
Kirtland Underground Munitions & Maintenance Storage Complex[a] (KUMMSC)	$7.5x10^{-8}$
Lovelace Hospital	$7.0x10^{-9}$
National Atomic Museum	$1.3x10^{-8}$
Riding Stables	$3.2x10^{-8}$
Sandia Base Elementary School	$8.5x10^{-9}$
Shandiin Day Care Center	$1.1x10^{-8}$
Isleta Gaming Palace	$1.4x10^{-8}$
Veterans Affairs Medical Center	$1.4x10^{-8}$
Wherry Elementary School	$9.0x10^{-9}$

Sources: DOE 1997e, SNL/NM 1998a
MEI: maximally exposed individual
[a] The radiological MEI receptor location for normal operations
Note: Calculations were completed using *CAP88-PC*.

population increases the number of fatal cancers in the entire population within the ROI by $2.5x10^{-3}$. Therefore, no LCFs would be likely to occur in the ROI population due to SNL/NM radiological air releases.

Other receptors in the SNL/NM vicinity would receive lower exposures to radiation than the MEI, based on wind direction and distance from the facility sources. Radiation doses at specific receptor locations, including schools, hospitals, and day care centers in the SNL/NM vicinity are identified in Table 5.3.7–9. The range in potential human health effects associated with the radiation doses at several of these locations are shown in Table 5.3.8–2. The increase in lifetime cancer risk at many of the specific receptor locations from a 1-year dose from SNL/NM operations is lower than the increase in lifetime cancer risk to the MEI receptor located at the KUMMSC.

Receptors in the SNL/NM vicinity could also be exposed to air releases of radionuclides by way of the indirect pathway of ingesting food that contains radionuclides. *CAP88-PC* integrates doses from this pathway in the collective dose estimation for the population within the ROI, but does not integrate it into the exposure dose estimated for the potential onsite MEI receptor. Ingesting potentially contaminated foods accounts for approximately 11 percent (0.55 person-rem of the 5.0 person-rem collective population dose) of the population dose, which means it also accounts for approximately 11 percent of the health risk value. When the same percent contribution is assumed, this pathway potentially increases the lifetime risk of fatal cancer to the MEI by 11 percent ($8.3x10^{-9}$), less than 1 chance in 10 M.

Measures of Radiological Health Risks

The National Council on Radiation Protection and Measurements has adopted numerical values, known as risk estimators, that associate radiation dose to increased risk of developing fatal cancer. These values were recommended by the International Council on Radiation Protection and Measurement (ICRP 1991).

The risk estimator of 500 excess fatal cancers per 10^6 (million) person-rem, used to assess health effects to the public, takes into account children, the elderly, and other potentially sensitive receptors. The risk estimator of 400 excess fatal cancers per 10^6 (million) person-rem, used for workers, is a lower number, assuming that the worker population is a healthy adult population.

A 1 M person-rem exposure dose is equivalent to 1 million people exposed to 1 rem each. That is, 0.0005 fatal cancers per person-rem and 0.0004 fatal cancers per person-rem are multiplied by the dose to obtain the number of fatal cancers from the exposure to radiation.

For an individual, excess cancer risk is the increase in the person's chance (probability) of getting fatal cancer in a lifetime. For the population, the risk of an excess latent cancer fatality (LCF) is the additional increase in the total number of cancer fatalities in the entire ROI population from the collective population radiation dose. For all practical purposes, an LCF of less than 1 means that no additional cancer fatalities are expected.

Nonfatal Cancers and Genetic Disorders

Radiation exposures can cause nonfatal cancers and genetic disorders. The National Council on Radiation Protection and Measurements (NCRP) has adopted risk estimators developed by the ICRP for the public for assessing these health effects from radiation (ICRP 1991). The public dose-to-risk conversion factors recommended for nonfatal cancer and genetic disorders are 100 and 130 health effects per 1 M person-rem, respectively. The SNL/NM maximum annual dose would increase the lifetime risk of nonfatal cancers and genetic disorders to the MEI by $1.5x10^{-8}$ and $2.0x10^{-8}$, respectively, which would be less than 1 chance in 50 M.

The SNL/NM annual collective dose to the ROI population would increase the number of nonfatal cancers and genetic disorders by $5.0x10^{-4}$ and $6.5x10^{-4}$, respectively, which is interpreted that no additional nonfatal cancers or genetic disorders would be likely to occur within the ROI due to radiological air releases from SNL/NM normal operations.

Transportation

The potential human health risks and accident fatalities associated with transporting various radiological materials for SNL/NM operations are discussed in Section 5.3.9. The ratio of the total travel distance to the distance traveled within the ROI determines the estimated dose to the population along the travel route within the ROI. The distance traveled within the 50-mile ROI is conservatively estimated as 10 percent of the total distance traveled. Therefore, 10 percent of the total radiological dose (off-link and on-link) calculated for all radiological materials transported is considered as an additional human health impact to the population along the transport route within the ROI (see Appendix G). Ten percent of the annual collective population dose from transportation activities would increase the number of LCFs by $8.3x10^{-4}$, thus increasing the total number of fatal cancers in the ROI to $3.3x10^{-3}$. Therefore, it is likely that no additional LCFs would occur in the ROI population due to SNL/NM radiological material transportation activities, even when impacts are summed with impacts due to SNL/NM radiological air releases.

Historic Cancer Rate

For the U.S., the 1997 cancer mortality rate was 173 deaths per 100,000 persons. For the state of New Mexico, the rate was 146 deaths per 100,000 persons.

Composite Cancer Risk

The potential increase in lifetime cancer risk due to SNL/NM operations is associated with both the small amounts of radionuclides and small amounts of carcinogenic chemicals emitted into the air. Composite cancer risk due to both radiation and chemical exposures at the same location was assessed. To assess a composite cancer risk capturing the greatest potential cancer risk from exposure to radiation, the sum of the radiological MEI cancer risk and the chemical cancer risk at the same location (KUMMSC) was calculated. Cancer risk from the annual dose to the MEI, accumulated over a 30-year exposure duration, would be $2.3x10^{-6}$, or less than 1 chance in 434,000. Thirty years is consistent with the exposure used in calculating the chemical cancer risk at the KUMMSC; the contribution to cancer risk from exposure to chemicals would be so small that when the chemical cancer risk is added to the MEI fatal cancer risk, the value would not increase (the increased lifetime cancer risk remains $2.3x10^{-6}$). Therefore, the radiation exposure would be the majority of the risk (see Table E.6–3).

To assess a composite cancer risk capturing the highest potential cancer risk from chemicals, the upper bound value for cancer risk from chemicals, which assumes a hypothetical worst-case exposure scenario, and the radiological MEI (KUMMSC) cancer risk were summed. This is an impossible scenario because these exposures would not occur at the same location. However, it is a conservative assessment capturing the upper bound/ chemical risk (See Table E.6–3). The upper bound composite increased lifetime cancer risk would be $2.4x10^{-6}$, or less than 1 in 416,000. This would be within the EPA's established cancer risk range for the protection of human health of 10^{-6} to 10^{-4} (40 CFR Part 300). SNL/NM's potential contribution (from low exposures to chemicals and radiation) to an individual's lifetime cancer risk is very low, considering that overall in the U.S., men have a 1-in-2 lifetime risk of developing cancer, and for women the risk is 1-in-3. Approximately 1 out of every 4 deaths in the U.S. is from cancer (ACS 1997).

Worker Health and Safety

Operations at SNL/NM have to comply with DOE Orders, Federal Occupational Safety and Health Administration (OSHA) requirements, and occupational radiation protection requirements (10 CFR Part 835) for worker health and safety. These requirements regulate the work environment and minimize the likelihood of work-related chemical and radiation exposures, illnesses, and injuries. Periodic accidents, injuries, and illnesses do occur in the workforce. Most of the risks to worker health and safety are from common industrial accidents such as falls, slips, trips, contact with objects that result in sprains, cuts, abrasions, fractures, and other injuries to the body. Exposures to hazardous substances (chemical and radiological) are minimized or prevented through monitoring and using personal protective equipment. Overall, the SNL/NM injury and illness rates are much lower than those for private industry (national or local) and similar to those for the DOE as a whole (see Section 4.10).

Based on a 5-percent increase in the worker population under the No Action Alternative (Section 5.3.12) and the assumption that the SNL/NM nonfatal injury and illness rate per 100 workers would remain consistent with the 5-year average derived for 1992 through 1996, the total number of impacts to workers would increase slightly. Impacts for the entire SNL/NM workforce are projected to be zero fatalities per year, an average of 47 mrem/yr radiation dose (total effective dose equivalent [TEDE]) to the radiation-badged worker (based on the base year of 1996), approximately 311 nonfatal injuries and illnesses per year, and 1 or 2 confirmed chemical exposures annually.

Routine air emissions evaluated for potential exposures to specific receptors in the SNL/NM vicinity have the potential to impact noninvolved workers at SNL/NM. A noninvolved worker is an SNL/NM worker not associated with the operations of the facility and, therefore, not exposed during chemical or radiological work-related activities. Potential noninvolved worker exposures to airborne radiation are identified using the KUMMSC receptor location (Table 5.3.8–2). Potential noninvolved worker exposures to airborne chemicals are identified using a receptor location at the center of TA-I near the SNL/NM chemical facility sources. Based on an exposure scenario for a worker, health risks from chemicals to the noninvolved worker would be below a HI of 1 and less than 10^{-6} for an ELCR (see Appendix E, Table E.6–3).

Noninvolved Worker

A noninvolved worker is a SNL/NM worker not associated with the operations of the facility. For accidents, this worker is conservatively assumed to be located at 100 m from the accident for the entire duration of the accident in an unshielded condition. For routine operations, this worker is located nearest the source of emission.

The risk of cancer fatality from the annual average individual worker dose, annual maximum worker dose, and annual workforce collective dose for radiation workers (those working in radiation-designated areas) is shown in Table 5.3.8–3. Health risks from the annual average individual and annual maximum worker doses would be expected to remain constant for all three

Table 5.3.8–3. Radiation Doses (TEDE)[a] and Health Impacts to Workers from SNL/NM Operations Under the No Action Alternative

RADIATION WORKER DOSE RATES	RADIATION DOSE	RISK OF CANCER FATALITY FROM A 1-YEAR DOSE
Annual Average Individual Worker Dose	47[b] (mrem/year)	$1.9x10^{-5}$
Annual Maximum Worker Dose	845[b] (mrem/year)	$3.4x10^{-4}$
RADIATION WORKER DOSE RATES	**RADIATION DOSE**	**NUMBER OF LATENT CANCER FATALITIES**
Annual Workforce Collective Dose	17 (person-rem/year)	$6.8x10^{-3}$

Source: SNL/NM 1997k
mrem: millirem
TEDE: total effective dose equivalent
[a] Average measured TEDE means the collective TEDE divided by the number of individuals with a measured dose greater than 10 mrem.
[b] Annual average individual and annual maximum worker doses are expected to remain consistent with the baseline year 1996 (see Section 4.10).
Note: Because not all badged workers are radiation workers, "radiation workers" refers to those badges with greater than 10 mrem above background measurements used in the calculations.

alternatives (based on the Radioactive Exposure Monitoring System [REMS] database dose information for 1996) (see Appendix E, Section E.6.1.1). The annual workforce collective dose was estimated for the radiation worker population calculated under the No Action Alternative, based on the ICRP risk estimator of 400 fatal cancers per 1 M person-rem among workers, and was associated with $6.8x10^{-3}$ additional fatal cancers in the entire radiation worker population. For assessment purposes, this equates to no additional LCFs in the radiation worker population under the No Action Alternative.

Nonfatal Cancers and Genetic Disorders

The worker dose-to-risk conversion factor used to assess potential nonfatal cancers and genetic disorders is 80 health effects per 1 M person-rem. The SNL/NM annual workforce collective dose to the radiation worker population increases the number of nonfatal cancers and genetic disorders by $1.4x10^{-3}$ each. In other words, no additional nonfatal cancers or genetic disorders would be likely to occur in the radiation worker population under the No Action Alternative.

Nonionizing Radiation

Sources of nonionizing radiant energy at SNL/NM include both laser and accelerator facilities. The laser light source can damage the unprotected eye and may also damage equipment. The safety documents for the SNL/NM laser facilities report that these facilities operate in accordance with American National Standards Institute (ANSI) guidelines that require that light paths be isolated from workers and from other equipment (SNL/NM 1996b). Accelerators generate electromagnetic pulse (EMP) that could present a high-voltage hazard to personnel. ANSI guidelines require mitigation measures such as shielding to block high voltage hazards from personnel and, during tests shots, exclude personnel from high-bay areas. However, based on the measurements from pulsed-power facilities, the EMP exposures to personnel outside the high-bay would be less than the AC61 standard of 100 kV/m (SNL/NM 1996b). Therefore, routine high voltage impacts to SNL/NM workers and the public would not occur.

5.3.8.2 Accidents

This section describes the potential impacts to workers and the public from accidents involving the release of radioactive and/or chemical materials, explosions, and other hazards under the No Action Alternative. The methods used to estimate the accident impacts are described in Section 5.2.9. Additional details on the accident analyses and impacts are presented in Appendix F. Existing mitigation measures, engineered safety features, administrative controls, and the emergency planning and preparedness programs designed to prevent and/or minimize the impacts of accidents are described in Section 5.6.

Site-Wide Earthquake

An earthquake in the Albuquerque, New Mexico, area has the potential for human injury and building damage throughout the local region. Due to differences in structural design, SNL/NM buildings and structures vary in their capabilities to withstand earthquake forces. Any magnitude earthquake has the potential to cause injury to workers in and around buildings and damage to structures from the physical forces and effects of the earthquake. Additional injury to workers and the public would be possible from explosions and from exposure to chemical and radioactive materials that could be released from buildings and storage containers. Facilities in TA-I are the predominant source of chemical materials that could be released during an earthquake. Facilities in TA-V are the predominant source of radioactive materials that could be released. The ECF in TA-II is the predominant source of explosive materials. Lesser quantities of radioactive materials in TAs-I and -II could also be released and cause exposures to workers and the public.

The Uniform Building Code (UBC) specifies different levels of seismic design depending on the location and proposed use of a facility or structure. For office buildings and other nonhazardous use of buildings, the UBC specifies an acceleration of 0.17 *g* (approximately 6.0 on the Richter Scale) for the Albuquerque area. This level seismic design would apply to most buildings in TA-I. For those facilities that would contain radioactive materials, the UBC specifies an acceleration level of 0.22. In the event of a 0.17 *g* earthquake, various buildings in TA-I could be affected and various chemicals could be released (see Appendix F, Table F.7–7); larger magnitude earthquakes could cause more serious impacts. The only dominant chemical that changes among the alternatives is arsine, and it is not released in the earthquake at 0.17 *g* and lesser accelerations. Therefore, failure of facilities at lesser accelerations would not affect the differences in risk among the alternatives, and the spectrum of accidents would essentially be unchanged. The shape and direction of released chemical plumes would depend upon local meteorological conditions and physical structures. The plumes shown on Figure 5.3.8–3 are positioned to reflect the predominant wind direction during daylight hours. The daylight period was chosen to maximize the number of people potentially affected onsite, because more people are working onsite during the daytime than during nighttime periods. The circled area represents the potential area that could be affected by other wind directions. For wind blowing toward the north-northeast, there would be up to 423 people exposed to chemical concentrations above ERPG-2. Existing and known mitigation features designed to limit chemical release from storage containers, rooms, and buildings would limit or reduce plume size, concentration levels, and exposures. Emergency procedures, sheltering, and evacuations would also minimize exposures to workers and the public.

Nuclear facilities in TAs-I, -II, and -V could also be damaged during an earthquake. The frequency of an earthquake (0.17 *g*) that could cause the release of radioactive materials from TAs -I and -II facilities is 1.0×10^{-3} per year, or 1 chance in 1,000 per year. The frequency of a more severe earthquake (0.22 *g*) that could also cause the release of radioactive materials from TAs -I (NG-1), -II (ECF-1), and -V facilities is 7.0×10^{-4} per year or 1 chance in 1,500 per year. The consequences of a 0.22-*g* earthquake are shown in Table 5.3.8–4. If a 0.22-*g* earthquake was to occur, there would be less than one tenth of an additional LCF in the total population within 50 mi of the site. The largest impact to the MEI and largest impact to the noninvolved worker would be an increased probability of LCF of 6.9×10^{-6} and 3.0×10^{-2}, respectively, associated with the HC-1 accident scenario. The risks for these receptors can be estimated by multiplying these consequence values by the probability (frequency) of earthquake. If a stronger earthquake was to occur, larger releases of radioactive materials would be possible and could cause greater impacts.

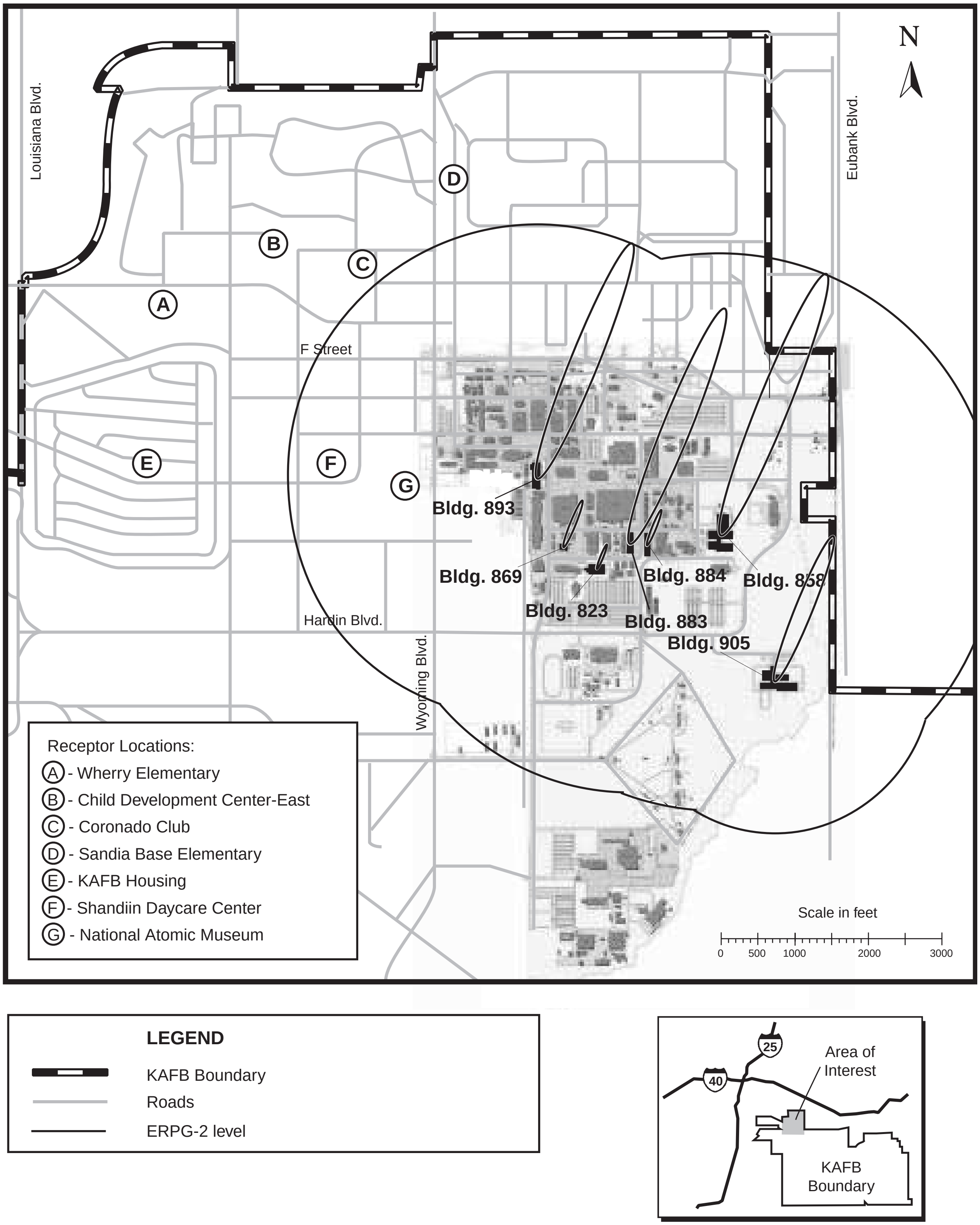
A severe earthquake could also cause damage to other SNL/NM facilities and result in environmental impacts. For example, the large quantities of oil stored in external tanks and in accelerator buildings in TA-IV could potentially be spilled and cause impacts to the ecosystem

The Richter Scale

The Richter Scale measures the strength of an earthquake. Only people very sensitive to motion changes can detect an earthquake that measures 3.5 or less on this scale. The worst earthquake ever recorded was 8.9 on the Richter Scale. A 0.2-gravity earthquake would measure in the range of 6.2 to 6.9 on the Richter Scale. The largest earthquake in New Mexico occurred in the Socorro area on November 15, 1906 and had a magnitude equivalent to about 6.0 on the Richter scale; it was felt throughout most of New Mexico and in parts of Arizona and Texas.

Emergency Response Planning Guideline Level 2

The ERPG-2 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.



Source: Original
Note: See Appendix F.7, Figure F.7–1

Figure 5.3.8–3. Areas Above Emergency Response Planning Guideline Level 2 from a Site-Wide Earthquake Under the No Action Alternative

The circled areas represent locations that could be above ERPG-2 levels, depending on wind direction.

Table 5.3.8–4 Site-Wide Earthquake Radiological Impacts Under the No Action Alternative

ACCIDENT ID[a]	FREQUENCY (per year)	ADDITIONAL LATENT CANCER FATALITIES WITHIN 50-MILES POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
			MAXIMALLY EXPOSED INDIVIDUAL[b]	NONINVOLVED WORKER[c]
TECHNICAL AREA -I				
NG-1	$7.0x10^{-4}$	$5.1x10^{-5}$	$1.4x10^{-9}$	$3.2x10^{-6}$
TECHNICAL AREA -II				
ECF-1	$7.0x10^{-4}$	$3.0x10^{-6}$	$1.5x10^{-10}$	$1.9x10^{-7}$
TECHNICAL AREA -V				
AM-2	$7.0x10^{-4}$	$2.0x10^{-3}$	$2.4x10^{-7}$	$7.4x10^{-5}$
HC-1	$7.0x10^{-4}$	$6.4x10^{-2}$	$6.9x10^{-6}$	$3.0x10^{-2}$
SP-1	$7.0x10^{-4}$	$9.2x10^{-3}$	$5.8x10^{-7}$	$2.7x10^{-4}$
AR-5	$7.0x10^{-4}$	$5.9x10^{-3}$	$8.4x10^{-7}$	$2.2x10^{-4}$

Source: Original (See also Appendix F, Tables F.7–4 and F.7–5)

[a] Facility Accident Descriptors:
- Neutron Generator Facility: NG-1
- Explosive Component Facility: ECF-1
- Annular Core Research Reactor-Medical Isotope Production: AM-2
- Annular Core Research Reactor-Defense Programs: AR-5
- Hot Cell Facility: HC-1
- Sandia Pulsed Reactor: SP-1

[b] The maximally exposed individual is located at the Golf Course and the consequences can be added.

[c] Because the noninvolved worker is located 100 meters from the release point, the location varies relative to each technical area. Therefore, the consequences to the noninvolved worker can only be added for a given technical area.

Note: 1) In the No Action Alternative, the Annular Core Research Reactor can be operated in either the medical isotopes production or Defense Programs configuration. The highest consequence (AR-5) was used.
2) The only earthquake radiological accident that changes among alternatives is AR-5, which contributes only 3.9 person-rem to the 150-person-rem dose. Therefore, failure of facilities at lesser accelerations that 0.22 *g* would not affect the differences in risk among the alternatives, and the spectrum of accidents would essentially be unchanged.

and water resources. Underground natural gas lines could break and ignite, causing brush and forest fires that could further damage facilities and injure persons in the vicinity. Hydrogen storage tanks in TA-I could be damaged, causing hydrogen combustion or explosion and potential injury to persons in the vicinity. Explosives in the ECF in TA-II and smaller quantities in other facilities could also be accidentally detonated during an earthquake with injury to persons in the vicinity. Occupants of all facilities would be at risk of injury as a result of the earthquake forces and building damage.

Facility Hazards

Some of the facilities at SNL/NM contain occupational hazards with the potential to endanger the health and safety of involved workers in the vicinity of an accident. Some of these facilities also contain hazardous materials that, in the event of an accident, could endanger the health and safety of people outside the immediate vicinity of an accident and beyond. These people include noninvolved SNL/NM workers, members of the military assigned to KAFB, and members of the public located within the KAFB boundary and offsite. Offsite consequences are determined to a 50-mile radius around the affected facility.

Explosion, radiological, and chemical accidents with the largest impacts to workers and the public have been analyzed, as discussed in the following sections. Potential accidents associated with other facility hazards such as lasers, electricity, x-rays, transformer oil, noise, explosive test debris, pyrotechnics, and compressed gases could affect the health and safety of the involved workers. However, the impacts to noninvolved workers and the public for these other accidents would be lower than the impacts from explosion, radiological, and chemical accidents described in the SWEIS (see Appendix F, Table F.6–3).

The DOE recognizes the potential adverse effects for workers, the public, and the environment that could result from the deterioration of SNL/NM equipment, structures, and facilities. However, the analysis of potential accidents discussed in this section assumes that deterioration of equipment, structures, and facilities would not affect the occurrence, progression, and effects of accidents. The basis for this assumption is that the DOE safety analysis process, specified in DOE Orders and standards, would require periodic assessments of facility safety to ensure that operations are being performed within an approved safety envelope. The process would also require an assessment of all unresolved safety questions that would result from any change in a facility or operation that could affect the operation's authorization basis. Depending on the results of the assessment, modifications to the facility and/or operational procedures would be implemented to maintain operations within the authorization basis.

Explosion Accidents

Explosive materials are stored, handled, transported, and used at some SNL/NM facilities. Administrative controls and facility design would help prevent an explosion accident and limit the impacts to personnel, if an accident was to occur. The ECF, for example, contains large quantities of explosives for use in its testing programs. Hydrogen trailers are another large source of explosive material. There are five hydrogen trailers parked near facilities or routinely transported to facilities from remote locations.

In the Draft SWEIS, the largest quantity of hydrogen with the highest potential for consequences to both SNL/NM workers and facilities was a set of horizontally mounted cylinders, with a storage capacity of approximately 90,000 standard cubic feet (SCF) located approximately east of the CSRL, Building 893, in TA-I. An explosion at the hydrogen cylinder location near the CSRL was selected for detailed analysis to estimate the bounding impacts of an explosion accident. If a hydrogen explosion was to occur in this relatively populated area of TA-I, individuals in the area could be injured and nearby property could be damaged. Involved workers within 61 ft of an explosion could be seriously injured and would have a 50 percent chance of survival. Involved workers out to a distance of 126 ft from the explosion could receive damage to their eardrums and lungs. The resulting overpressure from this explosion and impacts to personnel and property would diminish with distance.

Based on additional information gathered since the Draft SWEIS was published, the Final SWEIS bounding facility explosion would be in a cryogenic tank with a storage capacity of approximately 493,000 SCF, located northwest of the MDL, Building 858, in TA-I. An explosion at the cryogenic tank was selected for detailed analysis to estimate the bounding impacts of an explosion accident. If a hydrogen explosion were to occur in this relatively populated area of TA-I, individuals in the area could be injured and nearby property could be damaged. Involved workers within 101 ft of an explosion could be seriously injured and would have a 50 percent chance of survival. Involved workers out to a distance of 210 ft from the explosion could receive damage to their eardrums and lungs. The resulting overpressure from this explosion and impacts to personnel and property would diminish with distance, as shown in Table 5.3.8–5.

Table 5.3.8–5. Impacts of an Explosion Accident Under the No Action Alternative

P_r (psi)	PHYSICAL EFFECTS	DISTANCE (ft)	
		472-lb TNT	2203-lb TNT
50	50% survival rate for pressures in excess of 50 psi	61	101
10	50% rate of eardrum rupture and total destruction of buildings for pressures in excess of 10 psi	126	210
2.0	Pressures in excess of 2-3 psi will cause concrete or cinder block walls to shatter.	370	617
1.0	Pressures in excess of 1 psi will cause a house to be demolished.	657	1,096

Source: Original*
ft: feet
lb TNT: weight in pounds of equivalent mass of trinitrotoluene
psi: pounds per square inch
Note: See also Appendix F, Table F.4–1.

The actual number of persons in the vicinity of an accident depends upon many factors, making the actual number of potential fatalities uncertain. Factors include the time of day (morning, lunchtime, after hours), location of the people (or the amount of relative shielding), and spread of the pressure waves within a complex arrangement of buildings, alleys, and walkways.

This bounding facility explosion was postulated to occur from an accidental uncontrolled release of hydrogen, stored in a tank outside the MDL building, caused by human errors (such as mishandling activities) or equipment failures (such as a pipe joint failure), and the presence of an ignition source (such as a spark) near the location of release. For an uncontrolled release of hydrogen to explode, multiple failures would have to occur; therefore, this accident scenario would be extremely unlikely (that is, between $1x10^{-6}$ and $1x10^{-4}$ per year).

The human organs most vulnerable to shock explosions are the ears and lungs because they contain air or other gases. The damage would be done at the gas-tissue interface, where flaking and tearing could occur. Both the ear and the lung responses would be dependent not only on the overpressure, but also on impulse and body orientation; the shorter the pulse width, the higher the pressure the body could tolerate. An overpressure of approximately 50 psi would result in a 50 percent fatality rate; approximately 10 psi would result in eardrum rupture. These overpressure estimates are based on a square pressure wave with a pulse duration greater than 10 msec, and their effects could vary depending on body orientation to the pressure wave.

Structural damage produced by air blasts would depend on the type of structural material. An overpressure of 1 psi would cause partial demolition of houses (rendering them uninhabitable); an overpressure of 2 to 3 psi would shatter unreinforced concrete or cinder block walls; and an overpressure in excess of 10 psi would cause total destruction of buildings.

Radiological Accidents

The largest quantities of radioactive materials at risk for radiological accidents are located in TA-V. The Manzano Waste Storage Facilities, and TAs-I, -II, and -IV also contain radioactive material, but in smaller amounts. The nuclear facilities in TA-V include the ACRR, SPR, HCF, and Gamma Irradiation Facility (GIF). The New Gamma Irradiation Facility (NGIF) is under construction in TA-V. Accident scenarios for the ACRR facility were considered and analyzed for both the medical isotopes production and DP testing configurations. The HCF has been reconfigured for medical isotopes production, and the accidents analyzed reflect this mode of operation. Accidents have also been analyzed for storage of radioactive materials in the HCF not associated with medical isotopes production.

The most serious radiological accident impacts associated with facilities under the No Action Alternative are shown in Table 5.3.8–6. The table lists a set of accidents and their consequences in terms of an increased probability of an LCF for exposed individuals and increased number of LCFs for the offsite population. Other radiological accidents could also occur at these facilities, but their impacts would be within the envelope of the selected set of accidents.

The accident scenarios shown in Table 5.3.8–6 are briefly described below and in more detail in Appendix F.2.

The following descriptions correspond to accidents presented in Tables 5.3.8–4 and 5.3.8–6.

ACRR-Medical Isotopes Production

- *AM-1 Airplane Crash, Collapse of Bridge Crane*—For the ACRR facility, release from an airplane crash would be due to the bridge crane falling into the reactor pool, impacting the reactor superstructure, and resulting in the rupture of four fuel elements in the reactor core.
- *AM-2 Earthquake (0.22 g) and Collapse of Bridge Crane*—The postulated site-wide earthquake would cause the crane to fall onto the reactor superstructure with resultant rupture of four fuel elements. The releases for this scenario were assumed to be the same as those for the airplane crash scenario (scenario AM-1).
- *AM-3 Fuel Element Rupture*—This scenario would be initiated by a pinhole leak in the cladding of a fuel element through which water would be drawn by heat-up/cool-down cycles. Steam generation during a pulse might build up internal pressure and rupture the cladding. The fission products from one fuel element were assumed to be released into the reactor pool.
- *AM-4 Rupture of One Molybdenum-99 Target*—It was postulated that one target would rupture in the core after a 21-kW, 7-day irradiation. This accident was postulated to bound accidents involving targets that might take place during irradiation. The consequences were based on the rupture of one irradiated target in the target grid assembly in the reactor core.

Table 5.3.8–6. Potential Impacts of Radiological Facility Accidents Under the No Action Alternative

FACILITY/MODE	ACCIDENT ID	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	ADDITIONAL LATENT CANCER FATALITIES TO THE 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
					MAXIMALLY EXPOSED INDIVIDUAL	NONINVOLVED WORKER
Annular Core Research Reactor medical isotopes production configuration	***AM-1***	Airplane crash - collapse of bridge crane	$6.30x10^{-6}$	$2.0x10^{-3}$	$2.4x10^{-7}$	$7.4x10^{-5}$
	AM-3	Rupture of waterlogged fuel element	$1.0x10^{-2}$ to $1.0x10^{-4}$	$4.9x10^{-4}$	$5.4x10^{-8}$	$3.8x10^{-6}$
	AM-4	Rupture of one molybdenum-99 target	$1.0x10^{-4}$ to $1.0x10^{-6}$	$3.9x10^{-4}$	$4.3x10^{-8}$	$3.0x10^{-6}$
	AM-5	Fuel handling accident - irradiated element	$1.0x10^{-4}$ to $1.0x10^{-6}$	$4.9x10^{-3}$	$6.1x10^{-7}$	$7.6x10^{-5}$
	AM-6	Airplane crash and fire in reactor room with unirradiated fuel and targets present	$6.3x10^{-6}$	$1.6x10^{-6}$	$1.0x10^{-10}$	$4.9x10^{-8}$
	AM-7	Target rupture during Annular Core Research Reactor to Hot Cell Facility transfer	$<1.0x10^{-6}$	$3.9x10^{-4}$	$4.9x10^{-8}$	$1.4x10^{-5}$
Hot Cell Facility medical isotopes production	***HM-1***	Operator error - molybdenum-99 target processing	$1.0x10^{-1}$ to $1.0x10^{-2}$	$3.8x10^{-5}$	$3.3x10^{-9}$	$1.6x10^{-7}$
	HM-2	Operator error - iodine-125 target processing	$1.0x10^{-1}$ to $1.0x10^{-2}$	$1.6x10^{-6}$	$1.0x10^{-10}$	$4.2x10^{-9}$
	HM-4	Fire in glovebox	$1.0x10^{-2}$ to $1.0x10^{-4}$	$2.6x10^{-3}$	$2.4x10^{-7}$	$2.3x10^{-6}$
Hot Cell Facility Room 108 storage	***HS-1***	Fire in room 108, average inventories	$3.3x10^{-5}$	$2.1x10^{-3}$	$1.8x10^{-7}$	$2.0x10^{-7}$
	HS-2	Fire in room 108, maximum inventories	$2.0x10^{-7}$	$7.9x10^{-2}$	$6.6x10^{-6}$	$7.4x10^{-6}$

Table 5.3.8–6. Potential Impacts of Radiological Facility Accidents Under the No Action Alternative (concluded)

FACILITY/MODE	ACCIDENT ID	ACCIDENT SCENARIO DESCRIPTION	ACCIDENT FREQUENCY (per year)	ADDITIONAL LATENT CANCER FATALITIES TO THE 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
					MAXIMALLY EXPOSED INDIVIDUAL	NONINVOLVED WORKER
Sandia Pulsed Reactor	***S3M-2***	Control-element misadjustment before insert	1.0×10^{-4} to 1.0×10^{-6}	1.2×10^{-3}	1.5×10^{-7}	2.5×10^{-4}
	S3M-3	Failure of a fissionable experiment	1.0×10^{-4} to 1.0×10^{-6}	7.9×10^{-3}	8.4×10^{-7}	3.8×10^{-3}
	SS-1	Airplane crash into North Vault storage vault	6.3×10^{-6}	9.2×10^{-3}	5.8×10^{-7}	5.5×10^{-4}
Annular Core Research Reactor Defense Programs Configuration	***AR-1***	Uncontrolled addition of reactivity	$<1.0 \times 10^{-6}$	7.3×10^{-3}	9.3×10^{-7}	1.2×10^{-4}
	AR-2	Rupture of waterlogged fuel element	1.0×10^{-1} to 1.0×10^{-2}	1.3×10^{-3}	1.7×10^{-7}	1.2×10^{-5}
	AR-4	Fire in reactor room with experiment present	1.0×10^{-4} to 1.0×10^{-6}	9.0×10^{-3}	1.0×10^{-6}	1.4×10^{-4}
	AR-6	Airplane crash - collapse of bridge crane	6.3×10^{-6}	5.9×10^{-3}	8.4×10^{-7}	2.2×10^{-4}

Source: Original

TA-V Facility Accident Descriptors:

ACRR - Medical Isotope Production: AM-1, AM-3, AM-4, AM-5, AM-6, AM-7

Hot Cell - Medical Isotope Production: HM-1, HM-2, HM-4

Hot Cell - Room 108 Storage: HS-1, HS-2

SPR: S3M-2, S3M3, SS-1

ACRR- Defense Programs: AR-1, AR-2, AR-4, AR-6

- *AM-5 Fuel Handling Accident, One Irradiated Fuel Element Rupture*—The accident was postulated to occur outside of the reactor pool, so there would be no pool mitigation. While being transferred from the ACRR pool to the GIF pool, an irradiated fuel element is dropped, impacts a hard surface, and ruptures.
- *AM-6 Airplane Crash and Fire in Reactor Room with Unirradiated Fuel and Targets Present*—The scenario postulates an airplane crash into the reactor building while the reactor is shut down in preparation for refueling. New fuel elements would be present in the reactor room awaiting insertion into the core. In addition, fresh targets would also be present, awaiting insertion after refueling. The airplane would penetrate the building and cause a large fire in the reactor room.
- *AM-7 Target Rupture During Transfer from ACRR to HCF*—A target rupture would occur in transit between the ACRR and the HCF as a result of an unspecified incident involving transport equipment or operation.

HCF

- *HM-1 Operator Error During Molybdenum-99 Target Processing*—An operator inadvertently opens the wrong valve or opens the correct valves at the wrong time. Mechanical failures of valves or transfer lines could occur, releasing the waste gases from the decay tank (cold trap).
- *HM-2 Operator Error During Iodine-125 Target Processing*—This scenario is similar to HM-1, but would occur while iodine-125 targets, rather than molybdenum-99 targets, are being processed. This scenario was postulated to occur 72 hours after irradiation. Cold trap valves would be left open when the gas is being transferred between decay storage tanks.
- *HM-4 Fire in Steel Containment Box Used for Processing Targets*—It was postulated that a large fire in the steel containment box would result in the release of the gases in the decay tank (cold trap), as in scenario HM-1, plus the fission products from one irradiated target being processed.
- *HS-1 Fire in Room 108*—A general combustible fire would be ignited by an event such as an electrical short, forklift incident, or other unspecified circumstance. Various radioactive materials ranging from fissile material to fission products in various forms would be stored in Room 108.
- *HS-2 Fire in Room 108*—This scenario, discussed above under the HS-1 scenario, involves a larger consequence and lower frequency.
- *HC-1 Earthquake (0.22 g) and Building Collapse*—This scenario is an earthquake-induced building collapse, with fire in a steel containment box and in Room 108 of the HCF. The impacts are represented by the impacts for accidents HM-4 and HS-1.

SPR

- *S3M-2 Control Element Misadjustment Before Pulse Element Insertion*—Control element positions are set for each operation to produce the desired pulse size. Control element misadjustment before pulse element insertion could result in a larger-than-anticipated superprompt critical pulse. The estimated upper limit total worth insertion of reactivity would result in the nearly complete destruction of the core and subsequent release of an abnormal amount of fission products into the reactor room and the environment.
- *S3M-3 Failure of a Fissionable Experiment*—The experiment involves the rapid heating of uranium or plutonium rods to excite the fundamental oscillation modes of the material. Plutonium experiments are required to incorporate two levels of containment; however, to encompass the worst-case, the scenario assumes no containment and the complete melt of 7,000 g of plutonium.
- *SS-1 Airplane Crash into North Vault (NOVA)*—The SWEIS analysis postulated an airplane crash into the vault, causing a large fire that releases stored radioactive material. An experiment containing plutonium-239, similar to the experiment used in scenario S3M-3 and representative of other plutonium components tested at TA-V, was assumed to be stored in the NOVA.
- *SP-1 Earthquake (0.22 g) and Building Collapse*—This scenario is an earthquake-induced SPR building collapse. This accident scenario is represented by the release from SS-1.
- *S4-1*. This scenario is the same as S3M-3, except that the accident would occur during operation of the SPR-IV reactor rather than the SPR IIIm reactor.

ACRR-DP

- *AR-1 Uncontrolled Addition of Reactivity*—An uncontrolled amount of reactivity is inserted into the core over a time frame of 80 msec. This accident is assumed to occur without regard to some initiating event or failure of a reactivity control system or violation of prescribed procedures. The absolute magnitude of the reactivity change could be caused by the addition of reactivity from either the removal of negative reactivity (control rods, transient rods, or negative worth experiment) or positive reactivity (positive worth experiment). In terms of operational capabilities, the reactivity would represent the total available in the transient bank coupled to an unplanned removal of a large negative worth experiment in the same time frame.

- *AR-2 Waterlogged Fuel Element Ruptures*—This event would be initiated by failure of a single waterlogged fuel element during a pulse from low initial power and subsequent damage to adjacent elements. The pulse would be assumed to occur when the maximum fission product inventories have built up in the core. Adjacent elements would be assumed to be damaged by the rupture of the waterlogged element. The analysis assumes failure of a total of four fuel elements, with ejection of the fuel from all four elements into the pool water.
- *AR-4 Fire in Reactor Room with Experiment Present*—A fire could affect fissionable material in an experiment, and small quantities of uranium oxide and other contaminants could be released into the local atmosphere. To bound the potential consequences of this type of scenario, the SWEIS conservatively assumed a large fire in the reactor room without specific analysis of combustible loading and ignition sources. Also, to bound the potential consequences, an experiment containing plutonium was assumed to be present in the reactor room.
- *AR-5 Earthquake (0.22 g) and Collapse of Bridge Crane*—This scenario is a seismic event that would cause the 15-ton bridge crane to fall directly on the reactor superstructure. This is assumed to damage 24 fuel elements (approximately 10 percent of the core) to the extent that their entire inventory would be released.
- *AR-6 Airplane Crash, Collapse of Bridge Crane*—In order to bound the consequences of an airplane crash, it was postulated that the crash would knock the bridge crane off its rails onto the reactor superstructure. The SWEIS analysis postulates that an airplane crash would cause collapse of the bridge crane, which would be assumed to fall directly on the reactor superstructure and damage 24 fuel elements (approximately 10 percent of the core).

NGF

- *NG-1 Catastrophic Release of NGF Tritium Inventory*—The SNL/NM SWEIS source documents provide the material at risk for this scenario in the form of facility tritium inventories of 836 Ci (SNL/NM 1998a).

ECF

- *ECF-1 Catastrophic Release of ECF Tritium Inventory*—The source documents indicate that the expected tritium inventory present at the ECF is 49 Ci. The tritium inventory is based on the amount involved in the shelf-life test (SNL/NM 1998a).

The accident for a single facility with the highest consequences to the public would be a fire in Room 108 at the HCF in TA-V (HS-2). If this accident was to occur, there would be an additional 7.9×10^{-2} LCFs in the offsite population within 50 mi of the site. There would be a increased probability of an LCF for an MEI and a noninvolved worker of 6.6×10^{-6} and 7.4×10^{-6}, respectively. The estimated frequency of occurrence for this accident is 2.0×10^{-7} per year, or less than 1 chance in 5,000,000 per year.

Involved workers run the highest risk of injury or fatality in the event of many radiological accidents discussed in this section as well as the many others that could occur. Although there are protective measures and administrative controls to protect involved workers, they are usually in the immediate vicinity of the accident where they could be exposed to radioactivity.

The impacts to the other receptors would be less than for the MEI. Details on the impacts to all receptors analyzed are provided in Appendix F.2.

Chemical Accidents

Many SNL/NM facilities store and use a variety of hazardous chemicals. The quantities of chemicals vary, ranging from small amounts in individual laboratories to bulk amounts in specially designed storage areas. In addition, the effects of chemical exposure on personnel would depend upon its characteristics, and could range from minor to fatal. Minor accidents within a laboratory room, such as a spill, could result in injury to involved workers in the immediate vicinity. A catastrophic accident such as a large uncontrolled fire, explosion, earthquake, or aircraft crash could have the potential for more serious impacts to involved workers and the public. A catastrophic accident could also release various chemicals from multiple release points and increase the potential for human exposure and serious injury.

In order to assess the impacts of chemical accidents in a bounding manner, chemical inventories at facilities were estimated and ranked using a systematic procedure described in Appendix F.3; that is, a risk hazard index (RHI). The RHI is an indicator of a specific chemical's potential to cause human injury and fatality that factors in the chemical toxicity, volatility, and inventory. For the chemical with the highest RHI in each building, a catastrophic accident involving total release of the building inventory was postulated as the bounding event, then estimates were made of chemical concentrations at various distances from the accident. The results are shown in Table 5.3.8–7. Building inventory values are shown for the source term release to reflect the variability and uncertainty in the actual amount of the chemical that could be present at the time of an accident. Similarly, estimates are shown for the range of distances within which the ERPG-2 would be exceeded. The ERPG-2 is an accepted guideline for public exposure (see Appendix F.3 for an explanation of the various ERPG levels).

In the event of a severe chemical accident in TA-I, involved workers, noninvolved workers, KAFB personnel, onsite residents, and onsite and offsite members of the public would be at risk of being exposed to chemical concentrations in excess of ERPG-2 levels. The number of individuals at risk during normal business hours is shown in Table 5.3.8–8. Although Table 5.3.8–8 shows the number of people at risk, the actual number exposed would depend on the time of day, location of people, wind conditions, and other factors.

As shown in Table 5.3.8–7, the dominant chemical accident would be a catastrophic release of arsine from Building 893 in TA-I. If the building arsine inventory (65 lb) were released, individuals within a distance of 6,891 ft from the point of release would receive exposures that exceed the ERPG-2. Figure 5.3.8–4 illustrates the KAFB locations that would be affected by these worst-case chemical accident scenarios involving the release of arsine or chlorine from Buildings 893 and 858, respectively. The plumes on the figure correspond to the areas within which the ERPG-2 would be exceeded. Some individuals within the ERPG-2 circle close to the release point could experience or develop irreversible or other serious health effects or symptoms that could impair their abilities to take protective action. For any release, the seriousness of an exposure would generally decrease for distances further from the point of release.

In the event of an aircraft crash or earthquake involving buildings with various chemical inventories, multiple chemicals would be released. Although the impacts of mixed chemicals could be greater than individual chemicals, their behavior, dispersion, and health effects can be complex and have, therefore, not been considered quantitatively. An earthquake could also cause the release of like chemicals from multiple buildings and lead to increased concentrations where individual plumes overlap. The potential and impacts for overlapping plumes are discussed in Appendix F.7.

Aircraft Crash

Military, civilian, and commercial aircraft with various cargo land and take off on runways adjacent to KAFB. These aircraft could potentially crash into or in the vicinity of SNL/NM facilities. If such an accident were to occur, it could act as an initiator of other events at a facility that could lead to the release of hazardous radioactive and/or chemical materials. The frequency of an aircraft crash into a facility at SNL/NM and the extent of injury to personnel and damage to property and the environment depend upon many factors. Factors include aircraft size, type, speed, and impact angle; air traffic patterns and takeoff/landing frequencies; and the dimensions of the facility and the robustness of its construction. Estimates of an aircraft crash into SNL/NM facilities have been made and are discussed in Appendix F, Section F.5. Aircraft crash frequencies were used where applicable as facility accident initiating events.

Other Accidents

Other types of potential accidents would have impacts that were not measured in terms of LCFs or chemical concentrations. These could cause serious injury or fatality for humans or impacts to the nonhuman environment such as the ecology, historic properties, or sensitive cultural sites.

- *Brush Fires*—Small fires are expected and planned for during outdoor testing that involves propellants and explosives. The potential exists for brush and forest fires when hot test debris or projectiles come in contact with combustible elements in the environment. One such incident was reported in 1993 in TA-III when a rocket motor detonated during a sled track impact test and resulted in a 40-ac brush fire. An accident at the Aerial Cable Facility in the Coyote Test Field resulted in a fire that swept up the side of a mountain before being extinguished by SNL/NM workers. Many others have occurred that were contained in the immediate vicinity of the test area. Measures would be taken to prevent fires and, should a fire occur, the effects would be mitigated by

Table 5.3.8–7. Potential Impacts of Chemical Accidents under the No Action Alternative

BUILDING	CHEMICAL	BUILDING INVENTORY (lb)	ERPG-2 LEVEL (ppm)	ERPG-2 EXCEEDANCE DISTANCE (ft)	FREQUENCY (per year)
823	Nitrous Oxide	32.17	125	351	$1.0x10^{-3}$ to $1.0x10^{-4}$
858	Chlorine	106.41	3		$1.0x10^{-3}$ to $9.7x10^{-5}$
869	Nitric Acid	18.6	15		$1.0x10^{-3}$ to $1.0x10^{-4}$
878	Nitrous Oxide	50	125	426	$1.0x10^{-3}$ to $3.2x10^{-5}$
880	Hydrofluoric Acid	2	20	NR	$1.0x10^{-3}$ to $1.0x10^{-4}$
883	Phosphine	6.8	0.5	3,357	$1.0x10^{-3}$ to $1.0x10^{-4}$
884	Hydrofluoric Acid	10	20		$1.0x10^{-3}$ to $1.0x10^{-4}$
888	Fluorine	0.07	1	NR	$1.0x10^{-3}$ to $1.0x10^{-4}$
893	Arsine	65	0.5	6,891	$1.0x10^{-3}$ to $1.0x10^{-4}$
897	Chlorine	4.4	3	699	$1.0x10^{-3}$ to $6.6x10^{-5}$
905	Thionyl Chloride	101.1	5		$1.0x10^{-3}$ to $9.0x10^{-5}$

Sources: DOE 1996f, NSC 1995 [See also Appendix F, Tables F.3–4 and F.5–2]
ERPG: Emergency response planning Guideline
ft: feet
lb: pound
NR: Not Reported. The model did not provide a plume footprint due to near field unreliability. No population estimations are available.
ppm: parts per million
TA: technical area
Note: Frequency ranges from $1.0x10^{-3}$ for an earthquake in TA-I to $1.0x10^{-4}$ for an airplane crash into a generic building.

823 Systems and Development
858 Microelectronics Development Laboratory
869 Industrial Hygiene Instrumentation Laboratory
878 Advanced Manufacturing Processes Laboratory
880 Computing Building
883 Photovoltaic Device Fabrication Laboratory
884 6-MeV Generator
888 Lightning Simulation Facility
893 Compound Semiconductor Research Laboratory
897 Integrated Materials Research Laboratory
905 Explosive Components Facility

Table 5.3.8–8. Maximum Impacts of Chemical Accidents on Individuals Within KAFB Under the No Action Alternative

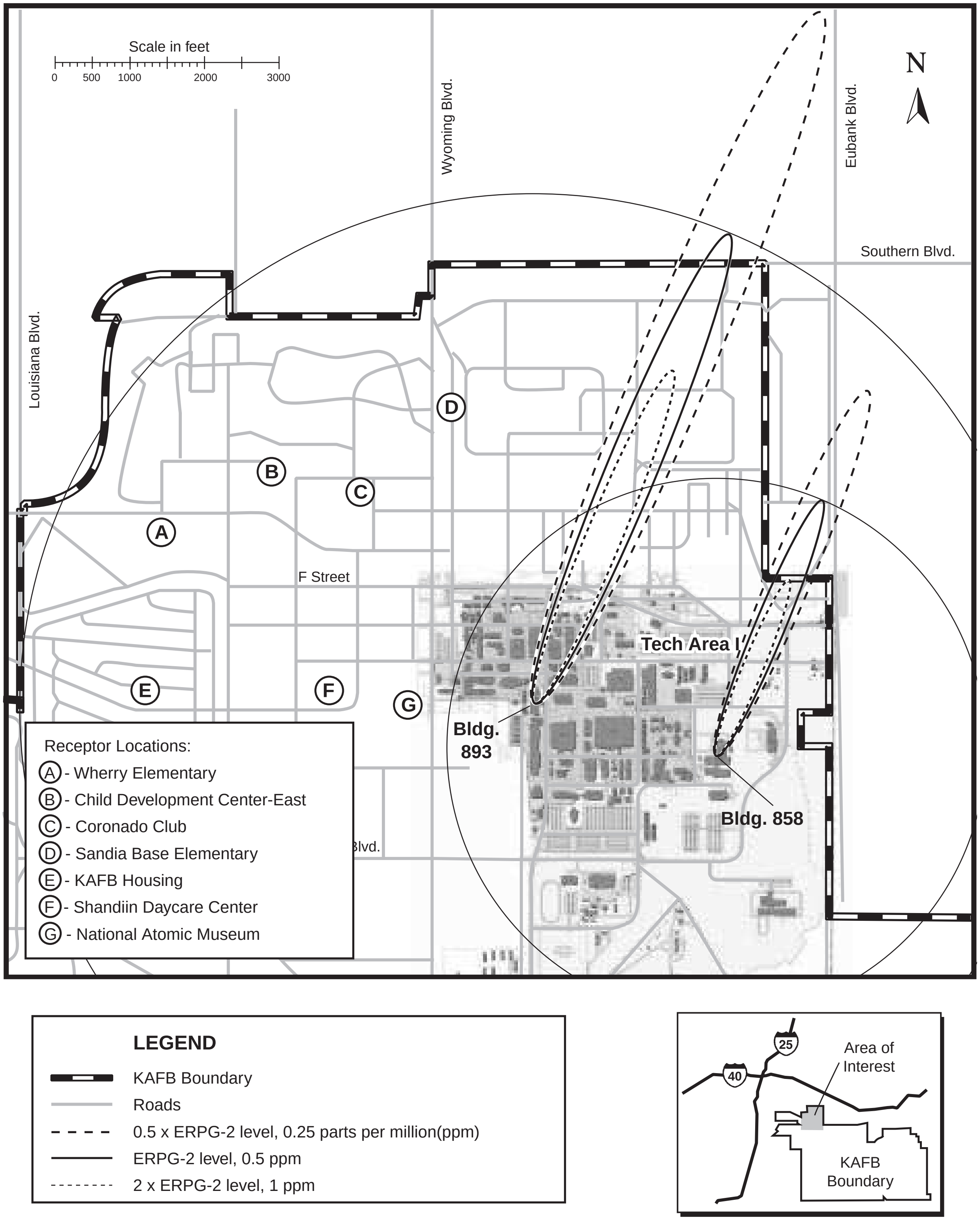
BUILDING	CHEMICAL NAME	RELEASE (lb)	ALOHA DISTANCE REQUIRED TO REACH ERPG-2 LEVEL (ft)	NUMBER OF PEOPLE WITHIN ERPG-2 PLUME
823	Nitrous Oxide	32.17	351	2
858	Chlorine	106.41	3,726	141
869	Nitric Acid	18.6	666	6
878	Nitrous Oxide	50	426	3
880	Hydrofluoric Acid	2	NR	NR
883	Phosphine	6.8	1,440	100
884	Hydrofluoric Acid	10	504	2
888	Fluorine	0.07	NR	NR
893	Arsine	65	4,884	409
897	Chlorine	4.4	699	5
905	Thionyl Chloride	101.1	2,067	55

Source: Bleakly 1998c (See also Appendix F, Table F.3–6)
ALOHA: Areal Location of Hazardous Atmosphere (model)
ERPG: Emergency Response Planning Guideline
ft: feet
lb: pound
NR: Not Reported. The model did not provide a plume footprint due to near-field unreliability. No population estimates are available.
823 Systems and Development
858 Microelectronics Development Laboratory
869 Industrial Hygiene Instrumentation Laboratory
878 Advanced Manufacturing Processes Laboratory
880 Computing Building
883 Photovoltaic Device Fabrication Laboratory
884 6-MeV Generator
888 Lightning Simulation Facility
893 Compound Semiconductor Research Laboratory
897 Integrated Materials Research Laboratory
905 Explosive Components Facility

activating fire fighting facilities in the test area (DOE 1995a, SNL/NM 1993d, SNL/NM 1998i).

- *Natural Phenomena*—Naturally occurring events such as tornadoes, lightning, floods, and heavy snow, as documented in existing SNL/NM safety documentation, were considered for their potential to initiate the accidental release of radioactive, chemical, and other hazardous materials that affect workers and the public. Any of these events, should they occur, could also lead to serious injury or fatality as a result of the physical and destructive forces associated with the events. The risks of such events to workers and the public would be equivalent to everyday risks from naturally occurring events to the general public wherever they work and reside.

- *Spills and Leaks*—The potential would exist throughout SNL/NM for the accidental spill of radioactive, chemical, or other hazardous materials. The effects of such spills on workers and the public through airborne pathways were considered earlier in this section. The impacts from pathways other than airborne would normally be bounded by exposure from airborne pathways. Any spill of a hazardous substance would have the potential for impacts to the nonhuman elements of the environment. A spill could make its way into surface and groundwater systems, affecting water quality and aquatic life. Spills of flammable substance could cause fires that damage plant and animal life and other land resources. There have been spills of hazardous substances at the SNL/NM site that had the potential to affect the nonhuman elements of the environment. In 1994,



Note: See Table 5.3.8–8

Figure 5.3.8–4. Projected Extent of Emergency Response Planning Guideline Level 2 from Accidental Release of Arsine (Bldg. 893) and Chlorine (Bldg. 858)

The encircled areas represent locations that could be above ERPG-2 levels, depending on the wind direction, for an accidental release of arsine (Building 893) or chlorine (Building 858) under the No Action Alternative.

over 100 gal of oil were spilled at the Centrifuge Complex in TA-III when a hydraulic pump failed during a centrifuge test, causing a potential impact to the nonhuman elements of the environment. Also in 1994, a small spill of transformer oil occurred from an oil storage tank in TA-IV when a gasket failed and, at the Coyote Test Field, a leaking underground storage tank containing ethylene glycol was discovered.

- *Radiological and Chemical Contamination*—Some accidents analyzed in this section, and others that were considered but not analyzed, could potentially impact the nonhuman elements of the environment. Any accidentally released chemicals would result in concentrations that would typically decrease with increasing distance from the point of release. While chemical concentrations would diminish over distance to a point where a human hazard would no longer be present, the concentrations could still affect other elements of the environment such as the ecology, water quality, and cultural resources. Radiological releases could also affect nonhuman elements of the environment. After an accident, SNL/NM, through their spill and pollution control and radiological emergency response plans, are required to assess the potential for ground contamination; if contamination exceeds guidance levels, plans will be developed for remediation.
- *Industrial*—In addition to radioactive and chemical materials and explosives, many SNL/NM facilities conduct operations and use materials and equipment that could also be potentially hazardous to workers. These hazards are typically referred to as normal industrial hazards, not unlike similar hazards that workers are exposed to throughout the nation, and include working with electricity, climbing ladders, welding, and driving forklifts. The SWEIS acknowledges the existence of, but does not analyze, normal industrial hazards. All operations and activities at SNL/NM facilities, as well as all DOE facilities, would be subject to administrative procedures and safety features designed to prevent accidents and mitigate their consequences should they occur.

5.3.9 Transportation

Under the No Action Alternative, transportation impacts were assessed for each of three ROIs: KAFB; major Albuquerque roadways; and major roadways between Albuquerque and specific waste disposal facilities, vendors, and other DOE facilities. This analysis involved estimating the number of trips made by SNL/NM-associated vehicles under normal operations in each of these transportation corridors. Transportation projections were based on data provided by SNL/NM or material inventory multipliers developed and presented in Appendix A.

5.3.9.1 Transportation of Material and Wastes

The number of material shipments received by SNL/NM is generally proportional to total SNL/NM material consumption. According to facility projections, material consumption under the No Action Alternative would increase by 84 percent overall through the year 2003, and by 96 percent through the year 2008. Therefore, total material shipments would also increase during the same time frame, although not necessarily for all types of material.

Radioactive and explosive material shipments are often delivered through government carriers, unless the quantities and activities being transported are low enough to meet the Federal guidelines and restrictions in place for authorized commercial transporters. Government carriers operate on an as-needed basis; thus, the increase in material inventory under the No Action Alternative would result in a similar increase in these kinds of shipments.

Due to their primary shipment method, there would be very little change to the number of chemical shipments made to SNL/NM. Chemicals that are ordered infrequently and in small quantities under the just-in-time (JIT) program are usually shipped to SNL/NM by way of commercial carriers such as Federal Express and United Parcel Service (UPS). These carriers make daily shipments to SNL/NM to deliver packages other than chemicals, and an increase in the volume of chemicals they handle per shipment would not generally increase shipment frequency. Similarly, major chemical vendors who deliver their own material, rather than use a commercial carrier, also usually make daily shipments to SNL/NM. Therefore, any increase in the volume of material that major vendors ship per load would not have an impact on the frequency of those shipments. Thus, chemical shipments would remain at approximately the same level regardless of the fluctuations in material consumption.

Considering the above factors, overall material transportation due to normal operations would increase by 50 percent over baseline levels through the year 2003 and by 52 percent through the year 2008. The anticipated annual and daily material receipts and shipments for each material category are presented in Table 5.3.9–1. The analysis assumed that SNL/NM has 250 work days per calendar year.

Table 5.3.9–1. SNL/NM Annual Material Receipts/Shipments Under the No Action Alternative

MATERIAL TYPE		BASE YEAR (1997) ANNUAL SHIPMENTS	NO ACTION ALTERNATIVE ANNUAL SHIPMENTS	
			2003	2008
Radioactive		305	562	597
Radioactive (medical isotopes production)	*Receiving*	0	16	16
	Shipping	0	1,140	1,140
Chemical		2,750	2,750	2,750
Explosive		303	557	593
TOTAL		**3,358**	**5,025**	**5,096**

Sources: FWENC 1998a, b; SNL/NM 1998s, 1998z, 1998a

Waste Transportation

With the exception of solid waste, the amount of waste shipped from SNL/NM to disposal facilities correlates directly to SNL/NM waste generation levels. Overall, waste shipments offsite would also increase under the No Action Alternative. Waste shipments for 2003 and 2008 include waste currently disposed of at the KAFB landfill, approximately 741 shipments for all alternatives. The total anticipated waste shipments during all operations for each type of waste are presented in Table 5.3.9–2 and Appendix G, Table G.3–3.

This analysis indicates there would be an actual 302 percent increase in all offsite waste shipments through the year 2003 and a 305 percent increase through the year 2008 under the No Action Alternative (see Appendix G for details). Of this increase, 285 percent is considered to be waste currently disposed of at the KAFB landfill. This leaves real increases of 17 percent through 2003 and 20 percent through the year 2008.

Table 5.3.9–2. Annual (Summary) Waste Shipments from Normal Operations Under the No Action Alternative

WASTE TYPE	BASE YEAR SHIPMENTS	2003 SHIPMENTS	2008 SHIPMENTS
LLW (1996)[a]	4	13	13
LLMW (1996)	1	3	3
Hazardous (RCRA+TSCA) (1997)	102	118	122
Recyclable[a,b] *(Hazardous and Nonhazardous) (1997)*	86	231	231
Solid[b] *(Municipal, Construction, and Demolition) (1997)*	51	650	650

Sources: Rinchem 1998a; SNL/NM 1998a, 1998y, n.d.(d)
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] Excludes decontamination and decommissioning
[b] Recyclable and solid wastes currently handled by the KAFB landfill could be shipped offsite in the future, contributing an additional 741 shipments.

Specials Projects

Two special project wastes, ER Project and legacy, were addressed separately due to their one-time operation/project status and in order to avoid skewing the SNL/NM normal operations impact. Legacy wastes would be anticipated to account for an additional 18 shipments of LLW, 3 shipments of LLMW, and 2 shipments of TRU/MTRU wastes over the 10-year time frame (see Figures 4.12–1, 4.12–2, and 4.12–3). In 1998 through 2000, the ER Project could account for up to a total of 312 offsite shipments of LLW, 101 offsite shipments of LLMW, 2 offsite shipments of RCRA waste, 5 offsite shipments of *Toxic Substances Control Act* (TSCA) waste, and 75 shipments of nonhazardous waste. Both of these special projects have been included within the total facility risks.

Offsite Receipts and Shipments of Material and Waste

The bounding case for this analysis assumed that each material and waste shipment is composed of two trips: one to and one from SNL/NM. Thus, in 2008, the total number of trips made by material and waste transporters under this alternative would be 12,296 (total shipments x 2). Assuming that the year is comprised of 250 work days, the average work day traffic within KAFB contributed by these carriers would be approximately 49 trips. This comprises 0.17 percent of all SNL/NM commuter trips (28,522 trips per day) entering and exiting KAFB in 2008. The total SNL/NM vehicular traffic under this alternative would comprise 36 percent of total 2008 KAFB traffic. SNL/NM waste and material truck traffic would account for 0.06 percent of KAFB traffic. Therefore, the overall KAFB traffic would remain constant under the No Action Alternative.

Shipments of Material and Waste in the Albuquerque Area

Total SNL/NM placarded material and waste shipments comprise 0.96 percent of the total placarded truck traffic shipments entering the greater Albuquerque area during the base year (1996 or 1997). Although a 70-percent increase in SNL/NM placarded material and waste truck traffic would be expected by 2008, the SNL/NM truck component would represent only 1.4 percent of all placarded trucks entering Albuquerque. This increase includes waste currently managed at the KAFB landfill and new shipments from medical isotopes production. ER Project wastes and legacy wastes are addressed separately under special projects. Thus, the impacts under the No Action Alternative would be negligible (see Table 5.3.9–3).

Placarded Trucks

Trucks that carry any quantity of a hazardous material are required to have U.S. Department of Transportation (DOT) markings on each side and end. These trucks are called placarded trucks. These markings, requirements, and exclusions are defined in 49 CFR Part 172.500. There are nine categories of material (hazard class or division number) placards, such as explosive, radioactive, oxygen, flammable gas, and combustible. Examples are shown below.

Table 5.3.9–3. 24-Hour Placarded Material and Waste Truck Traffic Counts Under the No Action Alternative

ROUTE (ALL TRAFFIC)[b]	BASE YEAR (1995) (480,577)[b]	2003 (526,712)[b]	2008 (555,547)[b]
I-25 North (52,400)	230	253	268
I-25 South (18,000)	94	103	110
I-40 West (16,400)	621	683	725
I-40 East (54,200)	569	626	664
TOTAL (141,000)	**1,514**	**1,665**	**1,767**
SNL/NM[c]	**14.5**	**24.3**	**24.6**

Sources: Scientific Services 1995, SNL/NM 1998a
I:Interstate
[a] Total vehicle count for all types of vehicles entering and departing Albuquerque[a]
[b] Bernalillo county population projections
[c] SNL/NM placarded trucks (daily average)

Shipments of Material and Waste Outside of Albuquerque

All material and waste transported by truck between SNL/NM and locations outside of Albuquerque typically enter and depart the city by way of Interstate-25 or Interstate-40. Table 5.3.9–3 presents the impacts to those corridors from material and waste shipments under the No Action Alternative. The specific remote facility locations are listed in Section 4.11. Daily SNL/NM material and waste truck figures were derived for comparison purposes by dividing the annual waste and material shipment totals in Tables 5.3.9–1 and 5.3.9–2 by the approximately 250 work days in a calendar year.

Albuquerque population projections were also taken into consideration. The 2020 Socioeconomic Forecast projects a 30-percent population increase in Bernalillo county from the base year (1995) (MRGCOG 1997b), and it was assumed for the bounding case that this would increase proportionally at a rate of 1.2 percent per year for all traffic. For this analysis, it was assumed the total placarded truck traffic would also increase by 1.2 percent annually.

The SNL/NM overall material and waste truck traffic component would be expected to increase from 14.5 shipments per day to 24.6 shipments per day by 2008. While this would represent a 70-percent increase in SNL/NM shipments per day, SNL/NM shipments of 24.6 per day would represent only 1.4 percent of the total number of shipments (1,767) on the Albuquerque interstates. Furthermore, the SNL/NM truck traffic would comprise less than 0.015 percent of all traffic, including all types of vehicles, projected to be entering and departing Albuquerque in 2008. For the base year (1996 or 1997), waste leaving Albuquerque represented 35 percent of the total shipments, with an additional 20 percent going to Rio Rancho. Because most materials are supplied through the JIT vendors, origination points are generally not known. However, most vendors use local suppliers; therefore, in the base year, 82 percent of material was assumed to be provided locally, with the remaining 18 percent coming from outside Albuquerque. Thus, the impact to this ROI from the No Action Alternative would be negligible.

5.3.9.2 Other Transportation (Traffic)

Overall vehicular traffic impacts under the No Action Alternative were assessed by projecting the total increased number of SNL/NM commuter vehicles traveling to and from SNL/NM in 2003 and 2008. The term "commuter" includes all vehicles operated by SNL/NM employees, contractors, and visitors; DOE employees; and additional traffic, such as delivery vehicles.

Traffic on KAFB

Table 5.3.9–4 presents general anticipated traffic impacts at KAFB under the No Action Alternative. The number of SNL/NM commuter vehicles traveling to the site each work day was conservatively assumed to increase at the same rate as the SNL/NM work force level (Section 5.3.12, Socioeconomics). KAFB operations and commuter levels were assumed to remain constant through 2008. Based on this analysis, overall KAFB traffic would increase by 1.8 percent under this alternative. Air quality impacts resulting from traffic are discussed in Section 5.3.7.

Table 5.3.9–5 shows projected 24-hour KAFB vehicular flow for each of the three main gates under the No Action Alternative. It was assumed that the Carlisle and Truman gates would be used primarily by KAFB personnel and not by SNL/NM employees. For the bounding case for this analysis, it was assumed that the SNL/NM contribution to total KAFB flow at each gate would fluctuate by the same factor as the total

Table 5.3.9–4. KAFB Daily Traffic Projections Under the No Action Alternative

COMPONENT	BASE YEAR (1996-1997)			2003			2008			CHANGE IN BASE YEAR BY 2008 (%)
	%	VEHICLES	TRIPS	%	VEHICLES	TRIPS	%	VEHICLES	TRIPS	
SNL/NM Commuters	36	13,582	27,164	37	14,125	28,250	37	14,261	28,522	5
KAFB Commuters	64	24,145	48,290	63	24,145	48,290	63	24,145	48,290	0
Total KAFB Commuter Traffic	**100**	**37,727**	**75,453**	**100**	**38,170**	**76,640**	**100**	**38,406**	**76,812**	**1.8**
SNL/NM Material & Waste Transporters	0.04	14.5	29	0.06	24.3	49	0.06	24.6	49	70[a]

Sources: SNL/NM 1997a, 1998a

[a] This increase represents inclusion of waste currently managed at the KAFB landfill and new shipments from medical isotopes production.

fluctuation in SNL/NM traffic under this alternative.

Based on this analysis, the daily KAFB gate traffic would increase by 1.8 percent under the No Action Alternative. This minimal change would not have an appreciable impact on service at the gates.

Short-term adverse traffic impacts would potentially occur onsite during routine construction activities at KAFB due to traffic lane restrictions, reduced speeds in construction areas, and traffic increases in slowly moving heavy equipment. These common occurrences would take place during the modification of Gibson Boulevard to Eubank Boulevard, as part of a bypass of KAFB, or any other construction project. The degree of traffic impact would be a function of the location, extent of the project scope, and duration. Building construction and onsite roadway rehabilitation are currently planned under the No Action Alternative. Short-term circulation impacts would potentially occur if vehicles are rerouted to avoid construction areas. However, it is anticipated that adequate detour routes and signage would be provided and that the impacts would be minimal and limited in duration.

Traffic in the Albuquerque Area

To determine the traffic impacts in the Albuquerque traffic corridor, roadways most likely to be affected by SNL/NM traffic were selected for analysis. The bounding case used the projected SNL/NM traffic contributions from Table 5.3.9–5 to approximate the SNL/NM component of the total traffic count for each roadway. For worst-case impacts, the SNL/NM traffic component was assumed to be equivalent to the total SNL/NM traffic at the nearest gate. In actuality, a significant percentage of traffic would likely diffuse onto other nearby roads, which would greatly reduce the magnitude of the SNL/NM component. The SNL/NM component was also assumed to increase at the same rate on each roadway in proportion to the SNL/NM projected work force level.

Albuquerque population projections were also taken into consideration. The 2020 Socioeconomic Forecast (MRGCOG 1997b) projects a 30-percent population increase in Bernalillo county from the base year (1995), and it was assumed for the bounding case that this would increase proportionally at a rate of 1.2 percent per year. For this analysis, it was also assumed the total roadway traffic flow would increase by the same 1.2 percent annually. The projected impacts to these roadways under the No Action Alternative, according to the bounding case factors, are presented in Table 5.3.9–6.

This analysis indicates that although SNL/NM traffic would increase slightly, the SNL/NM component of total Albuquerque traffic would actually decrease from 19 percent to 17 percent by 2008. This is due to the general population growth in Bernalillo county, which would exceed SNL/NM's growth rate.

Table 5.3.9–5. Total KAFB Gate Traffic Under the No Action Alternative

GATE	BASE YEAR (1996)			NO ACTION ALTERNATIVE						% CHANGE IN BASE YEAR BY 2008
				2003			2008			
	24-HOUR SNL/NM[a]	24-HOUR TOTAL[b]	PEAK HOUR[c]	24-HOUR SNL/NM	24-HOUR TOTAL	PEAK HOUR	24-HOUR SNL/NM	24-HOUR TOTAL	PEAK HOUR	GATE TOTAL
Wyoming	7,141	19,835	1,941	7,427	20,121	1,972	7,498	20,192	1,976	1.8
Eubank	5,324	14,788	2,683	5,537	15,001	2,726	5,590	15,053	2,731	1.8
Gibson	8,108	22,523	1,571	8,432	22,847	1,596	8,513	22,928	1,599	1.8
Average	6,858	19,048	2,065	7,132	19,323	2,098	7,200	19,391	2,102	1.8

Sources: USAF 1995e, SNL/NM 1997a

[a] SNL/NM commuter and transporter trips per day equals 36 percent of total KAFB trips per day

[b] Total KAFB trips per day

[c] Total KAFB trips per hour, 1996 traffic counts

Table 5.3.9–6. Albuquerque Daily Traffic Counts Under the No Action Alternative

ROADWAY		BASE YEAR[a] (480,577)[b]		2003 (526,712)[b]		2008 (555,547)[b]		% CHANGE IN BASE YEAR BY 2008
		DAILY[c]	PEAK[d]	DAILY	PEAK	DAILY	PEAK	DAILY
Gibson west at Louisiana	*TOTAL*	15,671	2,066	17,175	2,264	18,116	2,388	+15.6
	SNL/NM	8,108	1,069	8,432	1,111	8,513	1,122	+5
	% SNL/NM	52		49		47		-9.6
Wyoming south of Lomas	*TOTAL*	37,639	2,293	41,252	2,513	43,511	2,651	+15.6
	SNL/NM	7,141	435	7,427	452	7,498	457	+5
	% SNL/NM	19		18		17		-10.5
Eubank south of Copper	*TOTAL*	14,572	1,852	15,971	2,030	16,845	2,141	+15.6
	SNL/NM	5,324	677	5,537	704	5,590	710	+5
	% SNL/NM	37		35		33		-10.8
Interstate 25 at Gibson[e]	*TOTAL*	91,000		99,736		105,196		+15.6
	SNL/NM	8,108		8,432		8,513		+5
	% SNL/NM	8.9		8.5		8.1		-9.0
Interstate 40 at Eubank[e]	*TOTAL*	90,300		98,969		104,387		+15.6
	SNL/NM	5,324		5,697		5,590		+5
	% SNL/NM	5.9		5.8		5.4		-8.5
Wyoming north of KAFB gate	*TOTAL*	20,272	1,749	22,218	1,917	23,434	2,022	+15.6
	SNL/NM	7,141	612	7,427	636	7,498	642	+5
	% SNL/NM	35		33		32		-8.6

Sources: MRGCOG 1997b, 1997c; SNL/NM 1997b, 1998a; UNM 1997b

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

[b] Bernalillo county population projections

[c] Vehicles per day, *1996 Traffic Flows for the Greater Albuquerque Area*

[d] Vehicles per hour, *1996 – 1998 Traffic Counts*

[e] Peak hour counts are not available for this intersection.

Traffic Outside of Albuquerque

The additional local SNL/NM traffic under the No Action Alternative would have minimal impacts on transportation routes between Albuquerque and other DOE facilities, vendors, and disposal facilities (see Section 4.11 for a list of these facilities). In a worst-case assessment, the baseline year SNL/NM component would represent an average 18.8 percent of the total traffic count (144,000 vehicles per day) on major roadways entering and departing Albuquerque. This assumes that all SNL/NM traffic would actually enter and depart Albuquerque by way of the interstates every day, although a significant portion of SNL/NM traffic would more likely diffuse onto other roadways and remain in Albuquerque. Regardless, the overall SNL/NM traffic component would actually decrease under the No Action Alternative by the year 2008. This is due to the projected general population growth in Bernalillo county, which would exceed SNL/NM's growth rate.

Offsite and onsite transportation activities were compared to determine if offsite shipments were conservatively bounding for estimating risk to the public (see Appendix G). The primary factor considered was distance traveled and the potential for public exposure. The longest anticipated route for a routine shipment was selected for a conservative analysis. Mountaintop, Pennsylvania, was chosen for radioactive material and Silverdale, Washington, was chosen for explosive material. Both locations exceed 1,500 mi from SNL/NM. The longest distance chosen for onsite transfers was 12 mi. One 1,500-mi shipment would approximate 125 onsite transfers of 12 mi. Onsite transfers would be in areas of very limited public access compared to offsite transportation activities, providing another level of public protection. Based on these assumptions, offsite transportation hazards would bound onsite transfers.

5.3.9.3 Transportation Risks Associated with Normal Operations

Incident-Free Exposure

The representative conservative cases for this analysis used the distances traveled by SNL/NM waste and material carriers, as listed in Table 5.3.9–7. These distances were based on the average distance traveled by trucks in route to other facilities under the No Action Alternative.

Truck emissions are a function of the number of truck shipments to and from SNL/NM. The bounding case for a truck emissions impact analysis assumed that the greatest risk occurs when shipments are transported through urban areas, such as the Albuquerque transportation corridor, because these areas are most susceptible to emissions-related problems. To evaluate the actual risk associated with SNL/NM truck shipments, the most common origin and destination of all shipments of concern were compiled to determine the urban distance each material or waste would be transported (Section 4.11). Table 5.3.9–8 presents truck emissions impacts resulting from the No Action Alternative, projected for 2008, the year determined to pose the greatest increased risk.

Based on this analysis, the truck emissions due to increased SNL/NM truck traffic under the No Action Alternative would increase by 71 percent through the year 2008.

The radiological impact of exposure to incident-free routine transportation of radioactive materials was analyzed using *RADTRAN 4* (SNL 1992a), as described in Appendix G. Routes and population densities were modeled using *HIGHWAY* (Johnson et al. 1993). Results of these calculations are presented in Table 5.3.9–9.

In the absence of an accident that compromises package integrity, no incident-free chemical or explosive exposure would be foreseen to affect the public, workers, or vehicle transport crews under this alternative.

5.3.9.4 Transportation Risks Associated with Accidents

General Accidents

Accident impacts resulting from the No Action Alternative were developed using the projections for 2003 and 2008. The bounding case assumed that the percent increase in accidents would be equal to the percent increase in SNL/NM traffic under this alternative. Therefore, SNL/NM traffic accidents would increase from the base year (1996 or 1997) by 4 percent through 2003 and by 5 percent over the base year occurrences through the year 2008.

Hazardous Material/ Waste-Related Accidents

In conjunction with traffic fatality statistics (SNL 1986), the SNL/NM material and waste shipments projected in Table 5.3.9–1 and Table 5.3.9–2 were used to project the truck accident fatality incidence rate that would be expected under the No Action Alternative. Details of the analysis are presented in Appendix G. These impacts are presented in Table 5.3.9–10. Based on this analysis, accident fatalities due to SNL/NM truck transportation would nearly double through the year 2008. This would mean that fatalities would go from 0.22 in the base year (1996 or 1997) to 0.49 by 2008.

5.3.9.5 Radiological Transportation Accidents

The annual risks to the population due to transportation accidents that potentially involve radiological releases resulting from the No Action Alternative are presented in Table 5.3.9–11.

This analysis indicates that the incidences of LCFs due to the worst-case radiological transportation accident would increase from 1.2×10^{-3} to 2.6×10^{-5} LCFs by 2008 under the No Action Alternative. In addition, 2.2×10^{-3} LCFs could result from legacy and ER Project waste shipments. For more information, see Appendix G.

Risks due to radiological, chemical, and explosives accidents were evaluated and are discussed in detail in Appendix F. The bounding transportation accident analysis involves explosion of a tractor-trailer containing 40,000 ft^3 of hydrogen at standard temperature and pressure. Based on the results presented in Appendix F, Table F.4–1, the hydrogen explosion would result in structural damage to buildings up to a distance of 91 m from the truck. Fatalities would result up to a distance

Table 5.3.9–7. Truck Traffic Bounding Case Distances

MATERIAL TYPES[a]	ORIGIN-DESTINATION	DISTANCE (km)
Radioactive[b]	SNL/NM Bounding distance to Mountain Top, PA	3,022
Chemical	Albuquerque to SNL/NM	40
Explosive	SNL/NM to Silverdale, WA	2,406
LLW	SNL/NM to Clive, UT	1,722
LLMW[c] ***(Receipt)***	SNL/CA to SNL/NM	1,780
LLMW (Shipment)	SNL/NM to Savannah River Site, SC	2,548
Hazardous Waste (Shipment)	SNL/NM to Clive, UT	1,722
Hazardous Waste (Receipt)	Local	13
Hazardous Waste (California) (Recyclable)	SNL/NM to Anaheim, CA	1,306
Hazardous Waste (Local) (Recyclable)	SNL/NM to Albuquerque, NM	32
Hazardous Solid Waste (D&D)	Local	32
Nonhazardous Solid Waste (Recyclable)	Local	32
Nonhazardous Landscaping (Recyclable)	SNL/NM to Rio Rancho, NM	50
Solid Waste (Municipal and C&D)	SNL/NM to Rio Rancho Sanitary Landfill, NM	50
TRU/MTRU[d] ***Waste***	SNL/NM to Los Alamos National Laboratory, NM	167
Hazardous Waste TSCA-PCBs (D&D)	SNL/NM to Clive, UT	1,722
Hazardous Waste TSCA-Asbestos (D&D)	SNL/NM to Mountainair, NM	190
LLW (D&D)	SNL/NM to Clive, UT	1,722
Biohazardous Waste (Medical)	SNL/NM to Aragonite, UT	1,114
Legacy LLW (Storage)	SNL/NM to Clive, UT	1,722
Legacy LLMW (Storage)	SNL/NM to Savannah River Site, SC	2,548
Legacy TRU/MTRU (Storage)	SNL/NM to Los Alamos National Laboratory, NM	167
LLW (ER Project)	SNL/NM to Clive, UT	1,722
LLMW (ER Project)	SNL/NM to Savannah River Site, SC	2,548
RCRA Hazardous Waste (ER Project)	SNL/NM to Clive, UT	1,722
Nonhazardous Solid Waste (ER Project)	SNL/NM to Rio Rancho, NM	50

Sources: SNL 1992a, SNL/NM 1998a, DOE 1996h
C&D: construction and demolition
Ci: curies
D&D: decontamination and decommissioning
ER: environmental restoration
kg: kilograms
km: kilometers
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic waste
PCB: polychlorinated biphenyl
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic waste
TSCA: *Toxic Substances Control Act*
[a] Material types are used in or generated from normal operations unless otherwise noted.
[b] Shipment consisted of 100 kg of depleted uranium; the composition is given in Table 6.4–2.
[c] 1996 shipment of $7.2x10^{-6}$ Ci of sodium-24; Transport Index= 0.1
[d] 1997 shipment of americium-241, europium-152, cesium-137; Transport Index= 1.0

Table 5.3.9–8. No Action Alternative Incident-Free Exposure: Truck Emissions

CARGO	UNIT RISK[a] FACTOR PER URBAN KILOMETER	URBAN DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER ROUND TRIP SHIPMENT	ANNUAL SHIPMENTS			ANNUAL LCFs		
				BASE YEAR[b]	2003	2008	BASE YEAR[b]	2003	2008
NORMAL ROUTINE OPERATIONS									
RAD Materials	$1.0x10^{-7}$	73.0	$1.5x10^{-5}$	305	562	597	$4.6x10^{-3}$	$8.4x10^{-3}$	$9.0x10^{-3}$
Explosives	$1.0x10^{-7}$	48.0	$9.6x10^{-6}$	303	557	593	$2.9x10^{-3}$	$8.3x10^{-3}$	$5.7x10^{-3}$
Chemicals	$1.0x10^{-7}$	8.0	$1.6x10^{-6}$	2,750	2,750	2,750	$4.4x10^{-3}$	$4.4x10^{-3}$	$4.4x10^{-3}$
LLW	$1.0x10^{-7}$	33.0	$6.6x10^{-6}$	4	13	13	$2.6x10^{-5}$	$8.6x10^{-5}$	$8.6x10^{-5}$
LLMW (shipments)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	1	3	3	$8.1x10^{-6}$	$2.4x10^{-5}$	$2.4x10^{-5}$
LLMW (receipts)	$1.0x10^{-7}$	35.6	$7.1x10^{-6}$	0	1	1	0	$7.1x10^{-6}$	$7.1x10^{-6}$
Medical Isotopes Production (receipts)	$1.0x10^{-7}$	NA	NA	NA	16	16	NA	$2.0x10^{-3}$	$2.0x10^{-3}$
Medical Isotopes Production (shipments)					1,140	1,140			
Hazardous Waste	$1.0x10^{-7}$	33.0	$6.6x10^{-6}$	64	80	84	$4.2x10^{-4}$	$5.3x10^{-4}$	$5.5x10^{-4}$
Recyclable Hazardous to California	$1.0x10^{-7}$	23.0	$4.6x10^{-6}$	2	3	3	$9.2x10^{-6}$	$1.4x10^{-5}$	$1.4x10^{-5}$
Recyclable Hazardous to New Mexico	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	6	8	8	$7.8x10^{-6}$	$1.0x10^{-5}$	$1.0x10^{-5}$
Solid Waste	$1.0x10^{-7}$	10.0	$2.0x10^{-6}$	51	51	51	$1.0x10^{-4}$	$1.0x10^{-4}$	$1.0x10^{-4}$
D&D Hazardous Waste TSCA-PCBs	$1.0x10^{-7}$	33.0	$6.6x10^{-6}$	1	1	1	$6.6x10^{-6}$	$6.6x10^{-6}$	$6.6x10^{-6}$
D&D Hazardous Waste TSCA-Asbestos	$1.0x10^{-7}$	10.0	$2.0x10^{-6}$	14	14	14	$2.8x10^{-5}$	$2.8x10^{-5}$	$2.8x10^{-5}$
Biohazardous Waste	$1.0x10^{-7}$	24.0	$4.8x10^{-6}$	1	1	1	$4.8x10^{-6}$	$4.8x10^{-6}$	$4.8x10^{-6}$
Recyclable D&D Hazardous Waste	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	22	22	22	$2.9x10^{-5}$	$2.9x10^{-5}$	$2.9x10^{-5}$
Recyclable Nonhazardous Solid Waste	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	78	78	78	$1.0x10^{-4}$	$1.0x10^{-4}$	$1.0x10^{-4}$
Nonhazardous Landscaping Waste	$1.0x10^{-7}$	10	$2.0x10^{-6}$	NA	142	142	NA	$2.8x10^{-4}$	$2.8x10^{-4}$

Table 5.3.9–8. No Action Alternative Incident-Free Exposure: Truck Emissions (concluded)

CARGO	UNIT RISK[a] FACTOR PER URBAN KILO-METER	URBAN DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER ROUND TRIP SHIPMENT	ANNUAL SHIPMENTS BASE YEAR[b]	ANNUAL SHIPMENTS 2003	ANNUAL SHIPMENTS 2008	ANNUAL LCFs BASE YEAR[b]	ANNUAL LCFs 2003	ANNUAL LCFs 2008
Construction and Demolition Solid Waste	$1.0x10^{-7}$	10	$2.0x10^{-6}$	NA	599	599	NA	$1.2x10^{-3}$	$1.2x10^{-3}$
RCRA Hazardous Waste (receipt)	$1.0x10^{-7}$	3	$6.0x10^{-7}$	12	25	25	$7.2x10^{-6}$	$1.5x10^{-5}$	$1.5x10^{-5}$
LLW (D&D)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	4	4	4	$2.6x10^{-5}$	$2.6x10^{-5}$	$2.6x10^{-5}$
TOTAL[bc]							**$1.33x10^{-2}$**	**$2.3x10^{-2}$**	**$2.4x10^{-2}$**
SPECIAL PROJECT OPERATIONS/TOTAL SHIPMENTS									
TRU/MTRU	$1.0x10^{-7}$	8.4	$1.7x10^{-6}$	0	1	3	0	$1.7x10^{-6}$	$5.1x10^{-6}$
TRU/MTRU (legacy)	$1.0x10^{-7}$	8.4	$1.7x10^{-6}$	0	0	2	0	0	$3.4x10^{-6}$
LLW (legacy)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	0	56	0	0	$3.7x10^{-4}$
LLMW (legacy)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	0	0	8	0	0	$6.5x10^{-5}$
LLW (ER)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	0	136	0	0	$9.0x10^{-4}$
LLMW (ER)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	0	0	5	0	0	$4.1x10^{-5}$
Hazardous Waste (ER)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	0	113	0	0	$7.5x10^{-4}$
Nonhazardous Solid Waste(ER)	$1.0x10^{-7}$	10	$2.0x10^{-6}$	0	0	9	0	0	$1.8x10^{-5}$
TOTAL[bc]							**0**	**$1.7x10^{-6}$**	**$2.1x10^{-3}$**

Sources: DOE 1996h; SNL/NM 1982, 1997b, 1998a; SNL 1992a
D&D: decontamination and decommissioning
ER: environmental restoration
km: kilometers
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
NA: Not applicable
PCB: polychlorinated biphenyl
RAD: radiological
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] LCFs per km of urban travel
[b] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[c] Lifetime estimated LCFs from annual shipments and total special project shipments

Table 5.3.9–9. Doses to Crew and Public Under the No Action Alternative

CARGO	ANNUAL DOSE/ TRUCK CREW (PERSON-REM)			ANNUAL DOSE/ GENERAL PUBLIC (PERSON-REM)			ANNUAL LCFs		
	BASE YEAR[a]	2003	2008	BASE YEAR[a]	2003	2008	BASE YEAR[a]	2003	2008
NORMAL ROUTINE OPERATIONS									
RAD Materials [b]	9.8	18.0	19.1	82.4	151.7	161.2	4.5x10^{-2}	8.3x10^{-2}	8.8x10^{-2}
LLW	0.21	0.68	0.68	0.6	2.0	2.0	3.8x10^{-4}	1.3x10^{-3}	1.3x10^{-3}
LLMW [c]	1.6x10^{-4}	5.9x10^{-4}	5.9x10^{-4}	1.6x10^{-3}	6.4x10^{-3}	6.4x10^{-3}	8.6x10^{-7}	3.4x10^{-6}	3.4x10^{-6}
Medical Isotopes Production	NA	7.4	7.4	NA	21.2	21.2	NA	1.4x10^{-2}	1.4x10^{-2}
LLW (D&D)	0.21	0.21	0.21	0.60	0.60	0.60	3.8x10^{-4}	3.8x10^{-4}	3.8x10^{-4}
TOTAL							**4.6x10^{-2}**	**9.9x10^{-2}**	**0.1**
SPECIAL PROJECT OPERATIONS/TOTAL SHIPMENTS									
TRU/MTRU [e]	0	1.6x10^{-3}	4.8x10^{-3}	0	8.8x10^{-2}	2.6x10^{-2}	0	5.0x10^{-6}	1.5x10^{-5}
TRU/MTRU [e] ***(legacy)***	0	0	3.2x10^{-3}	0	0	1.8x10^{-2}	0	0	1.0x10^{-5}
LLW (legacy+ER)	0	0	10.0	0	0	28.8	0	0	1.8x10^{-2}
LLMW [c] ***(legacy+ER)***	0	0	2.1x10^{-3}	0	0	2.1x10^{-2}	0	0	1.1x10^{-5}
TOTAL [b]							**0**	5.0x10^{6}	1.8x10^{-2}

Sources: SNL 1986, 1992a; SNL/NM 1997b, 1998a; DOE 1996h
D&D: decontamination and decommissioning
ER: environmental restoration
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
NA: not applicable
RAD: radiological
rem: roentgen equivalent, man
TRU: transuranic
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Shipment consists of 100 kg of depleted uranium
[c] 1996 shipment of 7.2x10^{-6} Ci of sodium-24; Transport Index= 0.1
[d] Lifetime estimated total LCFs from annual shipments and total special project shipments
[e] 1997 shipment of americium-241, europium-152, cesium-137; Transport Index= 1.0

Table 5.3.9–10. Truck Transportation Traffic Fatalities Under the No Action Alternative

CARGO	TRAFFIC FATALITY RATE: CREW AND GENERAL PUBLIC PER SHIPMENT[a]	ANNUAL FATALITIES		
		BASE YEAR[b]	2003	2008
NORMAL ROUTINE OPERATIONS				
RAD Material	$3.5x10^{-4}$	$1.1x10^{-1}$	$2.0x10^{-1}$	$2.1x10^{-1}$
Explosives	$2.9x10^{-4}$	$8.8x10^{-2}$	$1.6x10^{-1}$	$1.7x10^{-1}$
Chemicals	$2.1x10^{-6}$	$5.8x10^{-3}$	$5.8x10^{-3}$	$5.8x10^{-3}$
LLW	$2.2x10^{-4}$	$8.8x10^{-4}$	$2.9x10^{-3}$	$2.9x10^{-3}$
Medical Isotopes Production	NA	NA	$6.0x10^{-3}$	$6.0x10^{-3}$
LLMW (shipments)	$3.0x10^{-4}$	$3.0x10^{-4}$	$9.0x10^{-4}$	$9.0x10^{-4}$
LLMW (receipts)	$2.1x10^{-4}$	0	$2.1x10^{-4}$	$2.1x10^{-4}$
Hazardous Waste	$2.2x10^{-4}$	$1.4x10^{-2}$	$1.8x10^{-2}$	$1.9x10^{-2}$
Recyclable Hazardous to California	$1.5x10^{-4}$	$3.0x10^{-4}$	$4.5x10^{-4}$	$4.5x10^{-4}$
Recyclable Hazardous to New Mexico	$1.6x10^{-6}$	$9.6x10^{-6}$	$1.3x10^{-5}$	$1.3x10^{-5}$
Solid Waste	$2.6x10^{-6}$	$1.3x10^{-4}$	$1.3x10^{-4}$	$1.3x10^{-4}$
D&D Hazardous Waste TSCA-PCBs	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$
D&D Hazardous Waste TSCA-Asbestos	$2.2x10^{-5}$	$3.1x10^{-4}$	$3.1x10^{-4}$	$3.1x10^{-4}$
Biohazardous Waste	$1.4x10^{-4}$	$1.4x10^{-4}$	$1.4x10^{-4}$	$1.4x10^{-4}$
Recyclable D&D Hazardous Waste	$1.6x10^{-6}$	$3.5x10^{-5}$	$3.5x10^{-5}$	$3.5x10^{-5}$
Recyclable Nonhazardous Solid Waste	$1.6x10^{-6}$	$1.2x10^{-4}$	$1.2x10^{-4}$	$1.2x10^{-4}$
Nonhazardous Landscaping Waste	$2.6x10^{-6}$	NA	$3.7x10^{-4}$	$3.7x10^{-4}$
Construction and Demolition Solid Waste	$2.6x10^{-6}$	NA	$1.6x10^{-3}$	$1.6x10^{-3}$
RCRA Hazardous Waste (receipt)	$6.7x10^{-7}$	$8.0x10^{-6}$	$1.7x10^{-5}$	$1.7x10^{-5}$
LLW (D&D)	$2.2x10^{-4}$	$8.8x10^{-4}$	$8.8x10^{-4}$	$8.8x10^{-4}$
TOTAL[c]		**0.22**	**0.40**	**0.42**
SPECIAL PROJECT OPERATIONS/TOTAL SHIPMENTS				
TRU/MTRU	$1.9x10^{-5}$	0	$1.9x10^{-5}$	$5.7x10^{-5}$
TRU/MTRU (Legacy)	$1.9x10^{-5}$	0	0	$3.8x10^{-5}$
LLW (Legacy)	$2.2x10^{-4}$	0	0	$1.2x10^{-2}$

Table 5.3.9–10. Truck Transportation Traffic Fatalities Under the No Action Alternative (concluded)

CARGO	TRAFFIC FATALITY RATE: CREW AND GENERAL PUBLIC PER SHIPMENT[a]	ANNUAL FATALITIES		
		BASE YEAR[b]	2003	2008
LLMW (Legacy)	$3.0x10^{-4}$	0	0	$2.4x10^{-3}$
LLW (ER)	$2.2x10^{-4}$	0	0	$3.0x10^{-2}$
LLMW (ER)	$3.0x10^{-4}$	0	0	$1.5x10^{-3}$
Hazardous Waste (ER)	$2.2x10^{-4}$	0	0	$2.5x10^{-2}$
Nonhazardous Solid Waste(ER)	$2.6x10^{-6}$	0	0	$2.3x10^{-5}$
TOTAL[c]		**0**	**$1.9x10^{-5}$**	**$7.1x10^{-2}$**

Sources: SNL 1986, 1992a; SNL/NM 1997b, 1998a
D&D: decontamination and decommissioning
ER: environmental restoration
LLW: low-level waste
LLMW: low-level mixed waste
MTRU: mixed transuranic
NA: Not applicable
PCB: polychlorinated biphenyl
RAD: radiological
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] Round trip
[b] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[c] Lifetime estimated total fatalities from annual shipments and total special project shipments

of 15 to 18 m from the truck, while eardrum ruptures would occur up to a distance of 36 m from the truck.

5.3.10 Waste Generation

Implementation of the No Action Alternative would not cause any major changes in the types of waste streams generated onsite. Except for new operations, waste generation levels at SNL/NM would remain constant or increase slightly, consistent with slight increases in laboratory operations. These increased waste volumes would be partially offset by increased waste minimization and pollution prevention programs, which project a 33-percent overall decrease in total waste disposal needs by FY 2000. Waste projections used for analysis do not take credit for potential waste minimization techniques that have not yet been implemented. Regardless, the increased generation activities would not exceed existing waste management disposal capacities.

For projection purposes, the baseline waste generation data were considered to be constant for existing facilities, with no major increases or decreases in the amount of wastes generated. Operations waste are considered to be derived from mission-related work. Nonoperations waste are generated from special programs. New operations are discussed separately in order to show the maximum likely existing operational increases. Waste generation levels for special program waste, such as for the ER Project, are derived separately from the representative facilities' projections under special projects. However, the amount of waste generated is anticipated to reflect proportional increases or decreases in SNL/NM activity levels over the next 10 years, with the exception of waste that would be generated by new operations. The waste quantities projected, listed in Table 5.3.10–1, represent a site-wide aggregate of quantities for each type of waste stream from existing selected facilities. As appropriate, the balance of operations (not selected facilities or special projects) waste generated is discussed within the individual waste sections. Units shown for each waste type are based on how industrial facilities charge commercial clients for disposal of these wastes.

5.3.10.1 Radioactive Wastes

Under the No Action Alternative, SNL/NM would potentially generate LLW, LLMW, and TRU and MTRU wastes. However, SNL/NM would not generate any high-level waste. Projections for waste generation at selected facilities from new and existing operations are shown in Appendix H.

Existing Operations

Under the No Action Alternative, SNL/NM anticipates a maximum 23 percent increase in the generation of LLW from existing operations over the next 10 years. LLW is

Table 5.3.9–11. Dose Risk to Population Due to Transportation Radiological Accident, Maximum Annual Radiological Accident Risk for Highway Shipments

CARGO	ANNUAL DOSE RISK TO POPULATION PERSON-REM			LCFs		
	BASE YEAR[a]	2003	2008	BASE YEAR[a]	2003	2008
NORMAL ROUTINE OPERATIONS						
RAD Materials [b]	2.3×10^{-2}	4.3×10^{-2}	4.5×10^{-2}	1.2×10^{-3}	2.2×10^{-3}	2.3×10^{-3}
LLW	2.3×10^{-3}	7.5×10^{-3}	7.5×10^{-3}	1.2×10^{-6}	3.8×10^{-6}	3.8×10^{-6}
LLMW [c]	4.6×10^{-11}	1.7×10^{-10}	1.7×10^{-10}	2.3×10^{-14}	8.5×10^{-14}	8.5×10^{-14}
Medical Isotopes Production	NA	1.5×10^{-2}	1.5×10^{-2}	NA	7.5×10^{-6}	7.5×10^{-6}
LLW (D&D)	2.3×10^{-3}	2.3×10^{-3}	2.3×10^{-3}	1.2×10^{-6}	1.2×10^{-6}	1.2×10^{-6}
TOTAL [d]				1.2×10^{-3}	2.2×10^{-3}	2.3×10^{-3}
SPECIAL PROJECT OPERATIONS/TOTAL SHIPMENTS						
TRU/MTRU [e]	0	2.4×10^{-8}	7.2×10^{-8}	0	1.1×10^{-11}	3.6×10^{-11}
TRU/MTRU [e] ***(Legacy)***	0	0	4.8×10^{-8} 6.8×10^{-6}	0	0	2.4×10^{-11}
LLW (Legacy + ER)	0	0	0.11	0	0	5.5×10^{-5}
LLMW [c] ***(Legacy + ER)***	0	0	6.0×10^{-10}	0	0	3.0×10^{-137}
TOTAL [d]				**0**	1.2×10^{-11}	$\mathbf{5.5 \times 10^{-5}}$

Sources: DOE 1996h; SNL 1992a; SNL/NM 1997b, 1998a
Ci: curies
D&D: decontamination and decommissioning
ER: environmental restoration
kg: kilograms
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
RAD: radiological
rem: roentgen equivalent, man
TRU: transuranic
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Shipment consists of 100 kg of depleted uranium
[c] 1996 shipment of 7.2×10^{-6} Ci of sodium-24; Transport Index= 0.1
[d] Lifetime estimated total LCFs
[e] 1997 shipment of americium-241, europium-152, cesium-137; Transport Index= 1.0

shipped offsite for final disposal. LLMW generation would increase by 19 percent for existing operations through 2008. Under the *Resource Conservation and Recovery Act, Part B Permit Application for Hazardous Waste Management Units* (SNL/NM 1996a), some treatment of the hazardous component of LLMW could be performed at SNL/NM (Table 4.12–2). LLMW for which no onsite treatment is available is shipped offsite for treatment and disposal. SNL/NM also projects that approximately 0.28 m^3 of TRU waste would be generated annually. The existing TRU/MTRU wastes stored onsite, as well as all future TRU/MTRU wastes, would be transferred to LANL for certification, prior to disposal at the Waste Isolation Pilot Plant (WIPP), as indicated in the Waste Management Programmatic Environmental Impact Statement (DOE 1997i) Record of Decision (ROD)(DOE 1998n). Projected MTRU waste generation would increase by 0.2 m^3 annually, approximately equal to one 55-gal drum. MTRU waste would also be transferred to LANL for certification. Existing SNL/NM operations would use less than 1 percent (0.21 percent) annually of the available radioactive waste storage capacity. This is considered to be less than significant.

New Operations

SNL/NM anticipates a maximum of 76.4 m^3 of LLW would be generated from new operations annually over the next 10 years. The majority of the increase would be

Table 5.3.10–1. Total Waste Generation Under the No Action Alternative

ALL WASTE		UNIT	BASE YEAR[a]	NO ACTION ALTERNATIVE 5-YEAR	NO ACTION ALTERNATIVE 10-YEAR
RADIOACTIVE WASTE					
Low-Level Waste (500 kg/m^3)	Existing Operations	m^3(kg)	16(8,000)	20(10,000)	20(10,000)
	New Operations	m^3(kg)	4(2,000)	75(37,500)	76(38,000)
	SNL/NM Balance of Operations	m^3(kg)	74(37,000)	74(37,000)	74(37,000)
	SNL/NM Total LLW	m^3(kg)	94(47,000)	169(84,500)	170(85,000)
	Percent change		0.0%	79.2%	80.4%
Low-Level Mixed Waste (550 kg/m^3)	Existing Operations	m^3(kg)	3.85(2,120)	4.58(2,520)	4.58(2,520)
	New Operations	m^3(kg)	0.20(110)	0.48(260)	0.48(260)
	SNL/NM Balance of Operations	m^3(kg)	0.28(150)	0.28(150)	0.28(150)
	SNL/NM Total LLMW	m^3(kg)	4.33(2,380)	5.34(2,940)	5.34(2,940)
	Percent change		0.0%	23.3%	23.3%
TRU Waste (310 kg/m^3)	Existing Operations	m^3(kg)	-	0.28(87)	0.28(87)
	New Operations	m^3(kg)	-	-	-
	SNL/NM Balance of Operations	m^3(kg)	-	-	-
	SNL/NM Total TRU	m^3(kg)	-	0.28(987)	0.28(87)
MTRU Waste (76 kg/m^3)	Existing Operations	m^3(kg)	0.45(34)	0.65(49)	0.65(49)
	New Operations	m^3(kg)	-	-	-
	SNL/NM Balance of Operations	m^3(kg)	-	-	-
	SNL/NM Total MTRU	m^3(kg)	0.45(34)	0.65(49)	0.65(49)
	Percent change		0.0%	43.8%	43.8%
RADIOACTIVE WASTE TOTAL[c]	**Existing Operations**	**m^3(kg)**	**20.34 (10,154)**	**25.10 (2,656)**	**25.21 (12,656)**
	New Operations	**m^3(kg)**	**4.62(2,110)**	**75.87 (37,760)**	**76.86 (38,260)**
	SNL/NM Balance of Operations	**m^3(kg)**	**73.92 (37,150)**	**73.92 (37,150)**	**73.92 (37,150)**
	SNL/NM Total Radioactive Waste	**m^3(kg)**	**98.88 (49,414)**	**174.88 (87,566)**	**175.99 (89,066)**
	Percent change		**0.0%**	**76.9%**	**78.0%**

Table 5.3.10–1. Total Waste Generation Under the No Action Alternative (concluded)

ALL WASTE	UNIT	BASE YEAR[a]	NO ACTION ALTERNATIVE	
			5-YEAR	10-YEAR
RCRA HAZARDOUS WASTE				
Existing Operations	kg	16,187	19,682	20,780
New Operations	kg	398	1,243	1,300
SNL/NM Balance of Operations	kg	39,267	49,544	52,278
SNL/NM Total RCRA Hazardous	kg	55,852	70,469	74,358
	m^3	44.3	55.9	59.0
Percent change		0.0%	26.2%	33.1%
SOLID WASTE				
SNL/NM Total Solid Waste[b]	m^3(kg)	0.6M (2,022)	0.6M (2,006)	0.6M (1,955)
Percent change		0.0%	-0.8%	-3.3%
WASTEWATER				
Existing Operations (net increase)	M gal	49	62	84
New Operations	M gal	0	4	4
SNL/NM Balance of Operations	M gal	231	224	216
SNL/NM Total Wastewater	M gal	280	290	304
Percent change		0.0%	+3.6%	+8.6%

Sources: SNL/NM 1997b, 1998a, 1998c, 1998t
m^3: cubic meter
kg: kilogram
LLMW: low-level mixed waste
LLW: low-level waste
M: million
M gal: million gallons
MTRU: mixed transuranic
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Individual breakdowns of solid waste for existing, new, and balance of operations are unavailable because of tracking methods.
[c] Numbers are rounded and may differ from calculated values.
Note: Densities provided are from Table H.3–1.

primarily due to the full implementation of medical isotopes production in 2003. These operations, described in the Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement (DOE 1996b), would account for over 80 percent of the total projected LLW in 2003 and 2008. However, due to the nature of the waste, it would be managed at the generation facility to minimize worker exposure until offsite disposal. LLMW generation from all new onsite sources would be a maximum of 0.48 m^3 annually through 2008.

SNL/NM does not expect to generate TRU or MTRU wastes from new operations. Approximately 190 kg of spent fuel would be generated over the 10-year period. Spent fuel is further discussed in Appendix A as a material resource.

Balance of Operations

The waste generation level for the balance of operations was determined for each type of radioactive waste (Table 5.3.10–1). Only LLW and LLMW would be affected. Balance of operations at SNL/NM would account for an additional 73.6 m^3 per year of LLW. These same operations would account for an additional 0.28 m^3 of LLW per year. The overall operations impact for this alternative would increase by 80 percent for LLW and 23 percent for LLMW.

Current Capacity

Previously generated radioactive wastes (legacy wastes) occupy approximately 494 m^3 of the available 11,866 m^3 of total radioactive waste storage capacity at the RMWMF and its associated storage areas. This represents

4.2 percent of the total available capacity. Therefore, there would be sufficient capacity to accommodate anticipated increases in radioactive wastes.

Special Projects

Projections indicate the ER Project, a special project beyond the scope of normal operations, will be the single largest waste generator at SNL/NM in 1998. The ER Project will produce a total of approximately 2,862 m^3 of LLW and 221 m^3 of LLMW, primarily contaminated soil and debris, prior to the end of the project in 2004. Projected ER Project waste volumes are presented in Table 5.3.10–2. ER Project wastes are stored and handled at the point of generation prior to disposal offsite. Management of ER waste is not expected to impact overall SNL/NM waste management operations. Actual field cleanup is now expected to be completed by 2002, with ER Project waste disposed of by 2004. Prior to disposal, ER Project waste must be properly characterized. Therefore, lag time is built into the project schedule between field remediation and actual disposal of waste.

5.3.10.2 Hazardous Waste

Existing Operations

As shown on Table 5.3.10–1, under the No Action Alternative, SNL/NM anticipates a maximum 33 percent increase (over the base year [1996 or 1997]) in the overall generation of RCRA hazardous waste through 2008. Projections for selected facilities for new and existing operations are presented in Appendix H. Projected RCRA hazardous waste generation is shown in Figure 4.12–4.

No appreciable change in the generation of explosive waste would occur. Therefore, the TTF, with a treatment capacity of 9.1 kg of waste per burn, would continue to accommodate those wastes generated from the Light-Initiated High Explosive Facility. The majority of explosive waste would be disposed of at SNL/NM or through KAFB.

New Operations

SNL/NM anticipates annual generation of a maximum of 1,300 kg of hazardous waste by new operations over the next 10 years. The majority of the increase would be primarily due to the full implementation of medical isotopes production operations associated with the Medical Isotopes Production Project (MIPP) in 2003. These operations, described in the Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement (DOE 1996b), would account for less than 2 percent of the total projected hazardous waste in 2003 and 2008.

New SNL/NM operations would use less than 1 percent annually of the available hazardous waste storage capacity, which is considered to be a minimal impact.

Balance of Operations

It was assumed that the RCRA hazardous waste levels for the balance of operations at SNL/NM would increase by the same proportion as RCRA wastes for selected facilities, because selected facilities represent the overall plant. Consequently, multipliers were used to project RCRA hazardous waste levels under all three alternatives. In the base year, the existing selected facilities generated 16,187 kg out of a total of 55,852 kg of all operational RCRA waste. The remainder, 39,267 kg, is the balance of operations RCRA hazardous waste. For 2003, this would increase to a maximum of 49,544 kg, and to 52,278 kg by 2008.

Current Capacity

The total volume of hazardous waste generated requiring offsite disposal at licensed/approved facilities would not exceed the existing 286.5 m^3 of storage and handling capacities at the HWMF and its associated storage buildings. The outside nonpermitted bermed storage area for nonhazardous waste is not included in the onsite storage capacity calculations. Projections indicate that a maximum of 26 percent of the existing hazardous waste capacity would be used. SNL/NM routinely ships hazardous waste to various offsite commercial disposal facilities. Most, if not all, waste is shipped in less than one year to meet regulatory requirements. Based on these projections and continued operations at selected facilities under the No Action Alternative, the hazardous waste generation impacts would continue to be minimal.

Special Projects

During field remediation, the ER Project would produce an additional 26 M kg of hazardous waste by 2002. Final disposal would be accomplished by 2004. Projected ER Project hazardous waste volumes are shown in Table 5.3.10–2. ER Project waste handling is discussed in Section 4.12.3.3.

Additionally, other facility maintenance and infrastructure support (as outlined in Section 2.3.5) would continue. This program would directly impact the quantity of TSCA hazardous waste requiring disposal. As a result, SNL/NM would continue to generate TSCA

Table 5.3.10–2. Estimated Volumes of Environmental Restoration Project Waste Generated From 1996 through 2000[a]

YEAR	MATRIX DEBRIS	SOIL	SOIL/ DEBRIS	SOIL/ DEBRIS/ PPE	PURGE W ATER	SEPTAGE	LIQUID	TOTAL (ft^3)	TOTAL (m^3)	TOTAL (kg)
HAZARDOUS WASTE (RCRA)										
1996	-	8,944.0	27.0	-	-	378.0	351.0	9,700.0	274.7	314,981
1997	1,080.0	140.4	-	-	-	-	7.0	1,227.4	34.8	39,957
1998	118,152.0	584,388	5,159.7	-	-	764.1	70.2	708,534	20,066.1	23 M
1999	-	16,019.1	8,499.6	-	-	-	7.0	24,525.7	694.6	796,402
2000	54,000	-	-	-	-	-	-	54,000	1,529.3	1.7 M
TOTAL	173,232	609,491.5	13,686.3	-	-	1,142.1	435.2	797,987.1	22,599.5	27.8 M
RADIOACTIVE WASTE (LLW)										
1996	540.0	8,217.7	-	1,809.0	-	2,646.0	-	13,212.7	374.2	429,046
1997	540.0	8,439.6	35.1	-	-	-	-	9,014.7	255.3	292,727
1998	540.0	77,728.7	7.0	-	-	-	-	78,275.7	2,216.8	2.5 M
1999	-	547	-	-	-	-	-	547	15.5	17,762
2000	-	-	-	-	-	-	-	-	-	-
TOTAL	1,620.0	94,933	42.1	1,809.0	-	2,646.0	-	101,050	2,861.8	3.2 M
MIXED WASTE (LLMW)										
1996	2,286.9	61	-	-	-	-	-	347.9	66.5	76,232
1997	3,518.1		-	-	-	-	-	3,572.1	99.6	114,240
1998	1,080.0	-	35.1	-	-	764.1	-	1,879.2	53.2	61,022
1999	27.0	-	35.1	-	-	-	-	62.1	1.8	2,017
2000	-	-	-	-	-	-	-	-	-	-
TOTAL	6,912.0	61	70.2	-	-	764.1	-	7,807.3	221.1	250,000

Table 5.3.10–2. Estimated Volumes of Environmental Restoration Project Waste Generated From 1996 through 2000[a] (concluded)

YEAR	MATRIX DEBRIS	SOIL	SOIL/ DEBRIS	SOIL/ DEBRIS/ PPE	PURGE W ATER	SEPTAGE	LIQUID	TOTAL (ft^3)	TOTAL (m^3)	TOTAL (kg)
TSCA WASTE										
1996	-	135.0	-	-	-	-	-	135.0	3.8	4,384
1997	-	189.0	-	-	-	-	-	189.0	5.4	6,137
1998	-	31,833	-	-	-	-	-	31,833.0	901.5	1.0 M
1999		31,023.0	-	-	-	-	-	31,023.0	878.6	1.0 M
2000	-	-	-	-	-	-	-	-	-	0
TOTAL	-	63,180	-	-	-	-	-	63,180	1,789.3	2.0 M
NONHAZARDOUS WASTE										
1996	-	1,350.0	27.0	-	-	-162.0	-	1,539.0	43.6	49,975
1997	-	-	2,646.0	-	-	-	-	2,646.0	74.9	85,921
1998	-	1,422.9	2,430.0	-	-	-	-	3,852.9	109.1	125,112
1999	-	-	1,350.0	-	-	-	-	1,350.0	38.2	43,837
2000	-	-	-	-	-	-	-	-		0
TOTAL	-	2,772.9	6,453.0	-	-	162.0	-	9,387.9	265.9	310,000
GRAND TOTAL	**181,764.0**	**770,438.4**	**20,251.6**	**1,809.0**	**0.0**	**4,714.2**	**435.2**	**979,412.4**	**27,737.5**	**33.6 M**

Source: SNL/NM 1998m
ER: Environmental Restoration
ft^3: cubic feet
FY: fiscal year
LLW: low-level waste
LLMW: low-level mixed waste
m^3: cubic meters
M: million
PPE: personal protective equipment
RCRA: *Resource Conservation and Recovery Act*
TSCA: *Toxic Substances Control Act*
[a] Baseline totals and projections generated by SNL/NM on 2/9/98; actual cleanup is now expected to be completed between FY 2003 and FY 2005, with ER Project waste disposed of prior to the end of the project.
Note: All wastes are assumed to have the average density for the 1997 LLW shipments.

hazardous waste, primarily polychlorinated biphenyls (PCBs) and asbestos that are removed from transformers and buildings. Since the main PCB relamping and transformer removal has been completed, quantities of TSCA waste have dropped to approximately 122,000 kg per year, and should remain at that level (Figures 4.12–5 and 4.12–6).

The total volume of TSCA waste would eventually decrease as the targeted facilities are removed. Currently, SNL/NM has 674 buildings providing a total of 5,020,014 gross ft^2 of office and operational space. The number of buildings would be reduced to 465 buildings totaling approximately 4,885,600 gross ft^2. This program would remove 138 small office buildings, temporary structures, and trailers accounting for 179,204 gross ft^2 within FY 1998 and FY 1999 at SNL/NM. During FY 2000 through FY 2002, 49 additional buildings, accounting for 108,937 gross ft^2, are potentially scheduled for removal. During FY 2003 to FY 2008, an additional 29 buildings would be removed with a total of 84,132 gross ft^2. To make up for the loss of office and operational space, seven additional buildings would be built, adding approximately 240,000 gross ft^2. No predictions are made for years beyond FY 2008. Separate NEPA review may be required in the future depending on the scale and extent of the work involved.

5.3.10.3 All Other Wastes

SNL/NM operations also involve the four additional waste management activity areas discussed below.

Biohazardous (Medical) Waste

The total volume of medical waste would generally remain a function of the total number of full-time employees and subcontractors at SNL/NM. In 1997, 2,463 kg of medical waste were disposed of at an approved offsite facility. Under the No Action Alternative, biohazardous waste generation would increase to 3,279 kg by 2008. The existing waste handling capabilities would be adequate to accommodate this waste. No additional offsite impacts would occur, because offsite disposal capacity would continue to be sufficient.

Nonhazardous Chemical Waste

In 1998, the ER Project will generate approximately 125,112 kg of nonhazardous waste (Table 5.3.10–2). The maximum quantity of operations nonhazardous waste generated annually at SNL/NM and managed by the HWMF would be 92,290 kg, based on the waste multiplier (see Appendix H) developed for RCRA hazardous waste (Rinchem 1998a). Existing commercial disposal facilities would still have adequate capacities to handle the continued generation of nonhazardous waste, thus no additional impacts would be anticipated.

Municipal Solid Waste

Site-wide solid waste generation trends at SNL/NM would generally remain a function of total building area and the number of full-time and subcontractor employees. This function is based on general building operations activities, such as maintenance and cleaning, and, to a lesser extent, the general office waste created by SNL/NM employees. Over the 10-year time frame, a decrease of an estimated 3 percent is anticipated. Despite the projected 5 percent personnel increase, no appreciable onsite impacts to disposal facilities would occur because existing waste handling capabilities are already in place. As existing buildings are replaced, personnel are moved to make more efficient use of the space. No additional offsite impacts would occur, because offsite disposal capacity would continue to be sufficient. However, a substantial amount of construction and demolition (C&D), a special class of solid waste, would potentially be generated under the facility modernization program described above. Quantities of C&D waste associated with the facility modernization program were projected to be similar to prior years. This waste is disposed of at KAFB and does not currently create an offsite impact. Table 5.3.10–3 summarizes construction debris disposal at the KAFB landfill. If this waste required shipment offsite, similar quantities would go to a regional commercial landfill.

Wastewater

Waste water would increase throughout SNL/NM due to varying levels of operation within each facility. SNL/NM would generate a maximum of approximately 304 M gal of wastewater annually. However, SNL/NM entered into a memorandum of understanding (MOU) with KAFB, the DOE, the city of Albuquerque, and the state of New Mexico to reduce its water use by 30 percent by 2004 (SNL/NM 1997p). The MDL is the single largest generator of wastewater at 77 Mgal per year (Table 3.6–1). Reduction efforts would focus on the MDL in order to reduce the amount of wastewater being generated. See Section 5.3.2 for additional discussion of wastewater quantities and capacities.

Table 5.3.10–3. SNL/NM Construction and Debris Waste Volumes Managed at KAFB

SOURCE	1996			1997			1998[a]		
	WASTE (yd^3)	TONNAGE CONVERSION	% OF TOTAL	WASTE (yd^3)	TONNAGE CONVERSION	% OF TOTAL	WASTE (yd^3)	TONNAGE CONVERSION	% OF TOTAL
CONSTRUCTION & DEMOLITION									
DOE	324.50	129.80	0.14	167.25	66.90	0.16	104.00	41.60	0.18
DOE Contractors	837.00	334.80	0.37	1,520.00	608.00	1.49	392.00	156.80	0.67
SNL/NM	4,177.05	1,670.82	1.84	4,563.00	1,825.20	4.47	2,140.25	856.10	3.68
SNL/NM Contractors	13,471.00	5,388.40	5.94	10,070.00	4,028.00	9.86%	4,293.00	1,717.20	7.38
TOTAL (yd^3 [m^3])	226,822.30 [172,000]	90,728.92	100	102,119.00 [77,600]	40,847.60	100	58,146.75 [44,200]	23,258.70	100
YARD AND LANDSCAPE									
DOE	10.00	1.50	0.75	-	-	0	-	-	0
DOE Contractors	-	-	0	-	-	0	-	-	0
SNL/NM	386.00	57.90	29.11	19.00	2.85	16.81	-	-	0
SNL/NM Contractors	427.00	64.05	32.20	17.00	2.55	15.04	-	-	0
TOTAL (yd^3 [m^3])	1,326.00 [1,000]	198.90	100	113.00 [86]	16.95	100	-	-	0
COMPOST AND WOODPILE									
DOE	206.25	30.94	1.89	80.00	12.00	1.21	16.00	2.40	0.88
DOE Contractors	-	-	0	2.00	0.30	0.03	-	-	0
SNL/NM	2,607.75	391.16	23.96	1,642.25	246.34	24.79	724.25	108.64	39.78
SNL/NM Contractors	527.00	79.05	4.84	217.00	32.55	3.28	40.00	6.00	2.20
TOTAL	10,885.25 [8,300]	1,632.79	100	6,625.00 [5,000]	993.75	100	1,820.75 [1,400]	273.11	100

Source: Houston 1998b
yd^3: cubic yards
[a] 1998 number represents January through June 1998

5.3.11 Noise and Vibration

The implementation of the No Action Alternative would result in a continuation of the noise and vibration impacts currently experienced during operations at SNL/NM facilities. Section 5.3.11.1 describes potential noise impacts, and Section 5.3.11.2 describes potential impacts from vibrations.

5.3.11.1 Noise

The environmental concern about noise is twofold: first, repetitive exposure to loud noise leads to hearing impairment and eventual hearing loss; and second, noise may be a community nuisance at levels below those that cause hearing impairment. Two noise provisions that apply to SNL/NM address these concerns. The first provision is DOE 5480.10, Contractor Industrial Hygiene Program, which sets standards to protect workers in noisy occupations. Under this provision, workers without hearing protection may only be exposed to continuous sources at 85 dBA for up to 8 hours per day and to impulse noise at 140 dBA per event. The Hearing Conservation Program was initiated by SNL/NM to comply with DOE 5480.10 by limiting the time workers are exposed to noise. The louder the noise, the shorter the allowable exposure time for a worker.

The second provision is the city of Albuquerque Noise Control Ordinance (Ord. 21-1975, §9–9–1). This ordinance sets a limit on the amount of noise that may be produced above ambient levels in the city limits. This ordinance applies to any SNL/NM operation that is loud enough to be heard in neighborhoods bordering KAFB and that exceeds the limits cited in the ordinance. The ordinance allows a maximum allowable limit of 50 dBA, or 10 dBA above the ambient noise level, whichever is greater.

The No Action Alternative provides for SNL/NM to operate at current planned levels, which include baseline background noise levels and short-term noise impacts from SNL/NM test activities. The number of impulse noise-producing test activities is projected to increase 20 percent over 1996 levels for 2003 and 35 percent over the 1996 baseline number of test activities by 2008. Background noise levels would continue at similar levels from generators, air conditioners, and ventilation systems, but would increase due to additional vehicular traffic and aircraft noise. The range of background noise associated with these sources ranges from 50 to 70 dB (SNL/NM 1997a).

Construction noise, resulting from building new facilities, such as Building 701 in TA-I currently under construction, also contributes to the No Action Alternative background noise levels at SNL/NM. Table 5.3.11–1 presents typical noise levels associated with construction equipment that

Table 5.3.11–1. Typical Noise Levels from Construction and Industrial Equipment

CONSTRUCTION ACTIVITY	EQUIPMENT	NOISE LEVEL AT 50 FEET dBA
Constructing Foundation	Truck	91
	Concrete mixer	85
	Jack hammer	88
	Pneumatic Tools	85
Erecting Work	Paver	89
	Derrick	88
Finishing Work	Truck	91
	Paver	89
Miscellaneous	Generator	76
	Compressor	81
	Winch	88

Source: SNL/NM 1997a
dBA: decibels, A-weighted scale

would contribute to the background noise levels at SNL/NM during construction activities. These construction noise levels would contribute to the ambient background noise levels for the duration of construction, after which ambient background noise levels would return to pre-construction levels.

Large-scale impulse noise producing activities, such as explosives detonations, generate a pressure wave that is an atmospheric phenomenon visualized as ripples produced when a stone is thrown into a still body of water. The sudden increase in atmospheric pressure produced by these traveling pressure waves, called overpressure, is initially greater than the ambient atmospheric pressure and is responsible for disturbances such as noise and for building damage such as glass breakage. Building damage is sometimes blamed on ground vibration caused by explosive detonations, whereas the damage is often the result of the traveling pressure waves. These impulse noise levels resemble a dull thud and generally are considered an annoyance because of "startle" effects and window vibrations.

Air blast noise is associated with SNL/NM test activities performed primarily at TA-III, the Coyote Test Field, and other outdoor test facilities. Table 5.3.11–2 presents a summary of the short-term noise impacts from SNL/NM test activities, including expected noise levels at various locations throughout KAFB. The table column labeled "Source" provides the maximum dB level of the originating test activity at the various test facilities at SNL/NM. The remaining columns present dB levels at various locations throughout SNL/NM and KAFB. The maximum noise level at a given receptor occurs at the ground hazard area boundary for a 1,000-lb explosive test at the 10,000-ft sled track, a 40-pound explosive test at the Terminal Ballistics Complex, and a 155-mm gun firing at the outdoor firing range.

Figure 5.3.11–1 presents noise contours at each of the SNL/NM test facilities producing air blast noise. The outside contour represents the 140-dB contour resulting from the maximum sound-producing event at the site. The receptor locations presented in Table 5.3.11–2 are also shown on the figure.

Figure 5.3.11–1 indicates that the 140 dB contour from tests performed at Thunder Range crosses into the Pueblo of Isleta buffer zone. The Thunder Range Complex was used from 1969 through 1993 to support development, safety, reliability, and certification tests of Atomic Energy Commission (AEC)/DOE weapon systems. The testing activity at the complex declined substantially during the early 1990s, and the last test at the complex was conducted during the third quarter of 1993. The current use is for the disassembly and evaluation of special items and siting for radar studies. Although the special items may contain explosive materials, the site is not used for explosives testing by SNL/NM.

Ground Hazard Area

The ground hazard area boundary is a delineated zone around a test site intended to restrict personnel from potentially harmful operations. These areas protect personnel from potential exposure to noise as well as toxic air emissions, metal fragments, and other potentially hazardous conditions. The ground hazard area is enforced by a combination of warning lights and signs, spotters, fences, barricades, and gates to demarcate the ground hazard area boundary. Personnel are required to leave a test site before testing and must evacuate beyond the ground hazard area boundary. Heavily constructed buildings at the test facilities shield personnel who remain inside the ground hazard area boundary to monitor tests. Procedures require personnel to remain indoors until a test is completed. Personnel wear hearing protection equipment approved by the DOE Line Support, Pollution Prevention, and Environmental Programs Department. The program satisfies the requirements of DOE 5480.10. Monitoring activities conducted by SNL/NM, indicate that exposure of the work force does not exceed allowable exposure limits (SNL/NM 1997a).

Located to the southwest of the Thunder Range is the Air Force Research Laboratory (formerly Philips Laboratory and Air Force Weapons Laboratory) Conventional High Explosives and Simulation Test (CHEST) Site, also shown on maps as Chestnut Site or Range. The Chestnut Range is used for explosive tests. Although SNL/NM explosive testing activities at Thunder Range have ceased, Chestnut Range continues to be used as an active explosives testing site by the USAF and its contractors. Table 5.3.11–2 presents short-term noise impacts at receptor locations located throughout KAFB from test activities performed at Thunder Range.

For each air blast test activity, the distance at which the 50-dB, 24-hour average noise level extends beyond the source is within the 140-dB contour. The city of Albuquerque

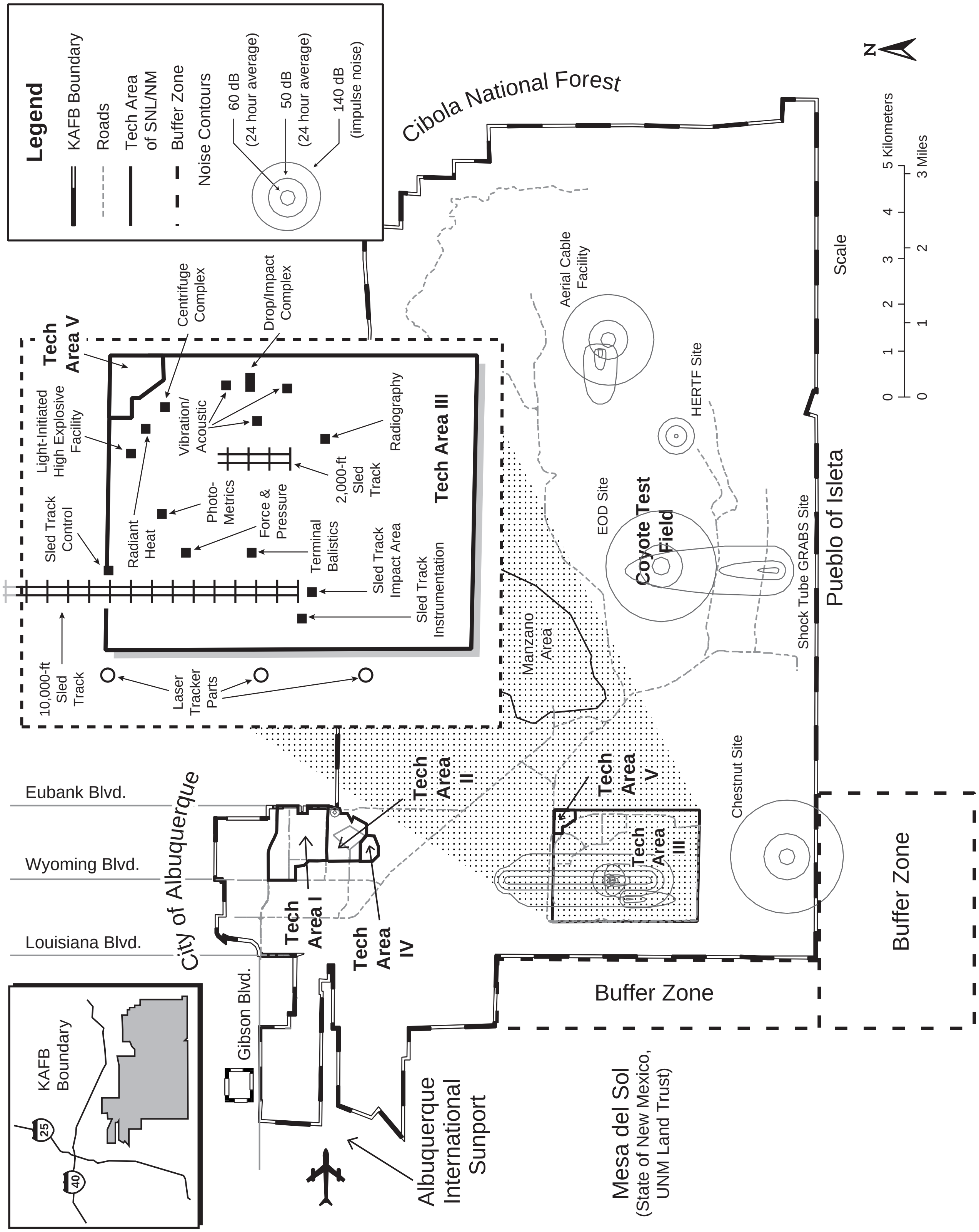
Table 5.3.11–2. Short-Term Noise Impacts of SNL/NM Test Activities (dB)

FACILITY	TIMES PER YEAR	SOURCE[a]	1[b]	2[c]	3[a]	4[a]	5[a]	6[a]	7[a]	8[a]	9[a]	10[a]	11[a]	12[a]	13[a]
10,000-FT SLED TRACK															
Explosive Weight (lbs TNT)															
50	32	151	131	96	96	109	102	103	103	113	123	115	110	111	114
250	4	156	136	101	102	114	108	108	108	118	128	120	115	116	119
1,000	10	161	140	106	106	119	112	113	113	123	132	125	120	120	123
Rocket Motors (numbers type)															
25 HVARs		137	119	100	100	101	96	103	103	107	121	107	106	106	125
1 Sprint	<1	155	137	118	119	120	115	122	122	126	140	126	125	124	143
Sonic Booms	100	149	131	112	112	114	109	116	116	120	134	120	118	118	137
Collision Impacts		145	127	102	102	109	104	106	106	113	123	115	111	111	115
CENTRIFUGE COMPLEX															
Explosives	3	140	126	88	88	93	87	100	100	140	113	116	122	122	107
Collision Impacts	50	117	105	76	76	78	75	83	83	117	93	95	101	101	88
Motors	3	86	64	35	35	37	34	42	42	76	52	54	60	60	47
TERMINAL BALLISTICS COMPLEX															
Explosive Weight (40 lbs TNT)	10	150	140	97	98	108	100	106	105	118	150	119	114	114	119
OUTDOOR FIRING RANGE															
155-mm gun	-	151	140	107	107	121	123	114	114	128	151	128	120	120	121
.30-caliber gun	-	100	80	47	48	54	48	52	52	61	90	62	58	58	62
DROP/IMPACT COMPLEX															
Rockets		135	117	92	92	100	93	98	99	113	107	135	108	111	104
Collision Impacts	100	119	109	76	76	84	77	83	83	97	91	119	92	95	88

Table 5.3.11–2. Short-Term Noise Impacts of SNL/NM Test Activities (dB) (concluded)

FACILITY	TIMES PER YEAR	SOURCE[a]	1[b]	2[c]	3[a]	4[a]	5[a]	6[a]	7[a]	8[a]	9[a]	10[a]	11[a]	12[a]	13[a]
RADIANT HEAT FACILITY															
Explosive Weight (< 1 lb TNT)	15	139	128	88	88	92	85	100	99	125	105	111	121	121	106
NORTH THUNDER RANGE															
Explosive weight (lbs TNT)															
50	150	NA	NA	116	117	121	119	122	124	127	127	130	126	127	124
250		NA	NA	121	123	126	124	127	129	132	132	135	131	132	129
450		NA	NA	123	124	128	126	129	131	134	134	137	133	134	131
SOUTH THUNDER RANGE															
Explosive weight (lbs TNT)															
50	120	NA	NA	115	116	122	121	120	121	124	126	127	124	124	123
1,000		NA	NA	125	126	132	131	130	131	133	135	136	133	133	132
4,000		NA	NA	129	130	136	135	134	135	138	140	141	138	138	137

Source: DOE n.d. (a)
dB: decibel
dBA: decibels, A-weighted scale
ft: foot
HVAR: High Velocity Aircraft Rocket
lb: pound
mm: millimeter
TNT: trinitrotoluene
[a] Area remote from most noise sources except distant aircraft and vehicular traffic
Noise range is 40-65 dBA
[b] Affected by aircraft operating from the Albuquerque International Sunport
Expected noise range 76-93 dBA
[c] Affected by aircraft operating from the Albuquerque International Sunport
Expected noise range 90-102 dBA
1: Ground Hazard Area
2: Military housing along Pennsylvania Street at KAFB
3: Mobile home trailer park in Four Hills
4: Western boundary of KAFB
5: Pueblo of Isleta boundary located south of SNL/NM. There are no residences along this boundary
6: Golf course at KAFB
7: Riding stables at KAFB
8: Centrifuge Complex
9: Terminal Ballistics Complex
10: Drop/Impact Complex
11: Main gate TA-III
12: TA-V
13: Sled Track Complex (Control Building)



Sources: DOE n.d. (a), SNL/NM 1997a

Figure 5.3.11–1. Noise Contours Produced by SNL/NM Test Facilities

Air blast noise produced by SNL/NM test facilities reach receptor locations in TA-III.

noise control ordinance is not violated as long as the extent of the 50-dB, 24-hour average noise level remains within the KAFB boundary (SNL/NM 1997a).

Noise from test activities at SNL/NM, including rocket motors, explosives, and large caliber guns, would have minimal effect on the nearby communities. Impulse noise from these activities would be of short duration and would be concentrated in the lower frequency range. Low frequency noises are not perceived well by humans because the human ear hears higher frequencies better. A loud steady or continuous noise above 85 dB would produce adverse effects on exposed people. For example, it would render conversation nearly impossible. A single impulsive noise, on the other hand, even as high as 130 to 140 dB, produced by a sonic boom, explosion, or collision impact test, would be concentrated in the low frequencies that are relatively unimportant in oral communication. In addition, brief noises would tend to be masked by continuous noise or background noise such as vehicular traffic.

5.3.11.2 Vibration

Vibration concerns include annoyance to residents of nearby neighborhoods and potential structural damage to buildings adjacent to KAFB from test activities generating ground vibration at SNL/NM. The threshold range where vibration is viewed as "unpleasant" varies from 0.1 inch to 4 inches per second. For the typical frequencies generated by explosives, the threshold for annoyance ranges from 0.2 inch per second to 0.5 inch per second. The threshold level at which minor structural damage can begin to occur in 0.01 percent of structures is set at 2.0 inches per second (DOE 1992b).

The frequency of impulse noise under the No Action Alternative, based upon projected frequencies of impulse noise testing activities for 2008, would increase approximately 35 percent above the 1996 baseline frequency. Although impulsive noise may produce a "startle reaction," window vibrations, or public annoyance in some people, the effects on the public would be minor. Ground vibrations would remain confined to the immediate test area within the ground hazard area.

5.3.12 Socioeconomics

The implementation of the No Action Alternative would result in no changes to the demographic characteristics, economy, and community services in the ROI. The following discussion of impacts is based on a bounding economic analysis.

Blast Overpressure Versus Ground Vibration

An explosion creates both blast overpressure and ground vibration, either of which is capable of causing disturbance and/or damage. When an explosive charge is detonated in air, the gaseous products expand rapidly and compress the surrounding air. The compressed air moves outward like a ripple on a pond with great speed, thus initiating a shock wave or region of blast overpressure. Depending on the difference between the region of high pressure and the surrounding air, the potential exists for disturbance or damage to be done to objects that are within the path of the pressure wave. For example, if an overpressure wave hits a glass window, the glass is subject to momentary high pressure on one side, which can result in its breaking. The potential for damage depends on how close a structure is to the blast and the magnitude of the explosion.

An explosion will also cause the ground to shake upon detonation. Like blast overpressure, this ground vibration moves out from the point of detonation like waves on a pond due to the elasticity of the earth. The potential for damage from ground vibration depends on how much the earth moves or shakes. The greater the movement, which is measured as inches per second, the more likely it is that structural damage will occur. As with blast overpressure, damage will be greater if a structure is closer to a large explosion.

5.3.12.1 Demographic Characteristics

The No Action Alternative would not likely result in any noticeable change in existing demographic characteristics within the ROI (Section 4.14.3). Overall expenditures and employment at SNL/NM should remain relatively constant through 2008, which would, in turn, tend to maintain demographic characteristics within the ROI.

5.3.12.2 Economic Base

The No Action Alternative would not likely result in any noticeable change in the existing economic base within the ROI (Section 4.14.3). The total estimated economic activity associated with SNL/NM in 1996 was $3.93 B (Table 5.3.12–1). This represented 9.3 percent of the activity in the ROI (DOE 1997j). Overall expenditures and employment should remain relatively constant

Table 5.3.12–1. SNL/NM's Impact on Central New Mexico's Economy if Operations Were to Increase 5 Percent

ECONOMIC MEASURE	FY 1996[a]			ASSUMING A 5% INCREASE IN OPERATIONS			
	SNL/NM	TOTAL ROI	PERCENT OF ROI	SNL/NM	TOTAL ROI	PERCENT OF ROI	PERCENT CHANGE
ECONOMIC ACTIVITY ($ BILLIONS)							
Direct expenditures	1.43			1.50			
Indirect and induced	2.50			2.63			
Total economic activity	**3.93**	**42.40**	**9.3**	**4.13**	**42.60**	**9.7**	**0.4**
Economic activity multiplier: 2.75[b]							
INCOME ($ BILLIONS)							
Net wages and salaries	0.48			0.50			
Indirect and induced	0.58			0.61			
Total income	**1.07**	**13.40**	**8.0**	**1.11**	**13.45**	**8.3**	**0.3**
Income multiplier: 2.21[b]							
EMPLOYMENT (NUMBER OF EMPLOYEES)							
SNL/NM employment	7,652			8,035			
Indirect and induced	18,826			19,765			
Total employment	**26,478**	**331,800**	**8.0**	**27,800**	**333,122**	**8.3**	**0.3**
Employment multiplier: 3.46[b]							

Source: DOE 1997j
FY: fiscal year
ROI: region of influence

[a] Modeled results from DOE 1997j
[b] The use of multipliers in calculating economic impacts in the ROI is explained in Section 4.14.3.

through 2008. Historically, increases or decreases in operational levels of activities at SNL/NM have been gradual and/or have fluctuated by 1 or 2 percent per year (SNL/NM 1997a).

For analysis and consideration, Table 5.3.12–1 presents an estimate of the impacts under the No Action Alternative on the ROI economy from a 5-percent increase in operational levels of activity and associated increases in expenditures, income, and employment, both direct and indirect, at SNL/NM. The 5-percent increase was selected to bound increases for the selected facilities under the alternative and potential indirect increases across all other SNL/NM facilities. Additionally, the historical increases have been gradual; the 5-percent increase was projected over the 10-year period of the SWEIS (SNL/NM 1998a, SNL/NM 1997a). If operations at SNL/NM were to increase by 5 percent over current levels, overall economic activity within the ROI would be expected to increase by about 0.4 percent, with slightly smaller increases in income and employment at about 0.3 percent. As presented in Table 5.3.12–1, a 5-percent increase in SNL/NM activity operational levels by 2008 would generate an increase in total economic activity in the ROI from $42.4 B to $42.6 B. This would amount to a total increase of $200 M in additional economic activity (an average increase of $20 M per year) within the ROI. Total income at SNL/NM would increase from $1.07 B to $1.11 B, for a total of $40 M in additional income (an average increase of $4 M per year). Total employment in the ROI would increase from 331,800 to 333,122 or a total of 1,322 additional jobs (an average increase of 132 jobs per year) within the ROI. The increased economic activity over the baseline would be small.

During the next 10-year period, contributory effects from other industrial and economic sectors within the ROI would reduce or mask some of SNL/NM's effects on the ROI economy. This reduction or masking would occur if the estimated total employment in the ROI increases from 331,800 to 403,605 by 2008

(UNM 1997b). The ROI is experiencing and is expected to continue to experience strong growth. For a discussion on socioeconomic cumulative impacts, see Section 6.4.12.

5.3.12.3 Housing and Community Services

The No Action Alternative would not likely result in any noticeable change in existing housing and community services within the ROI (Section 4.14.3). Overall expenditures and employment at SNL/NM should remain relatively constant through 2008, which would, in turn, tend to maintain housing availability, value, and levels of service. Contributory effects from other industrial and economic sectors within the ROI should reduce or mask SNL/NM's proportional impact.

5.3.13 Environmental Justice

As indicated in Sections 5.3.1, 5.3.2, 5.3.3, 5.3.5, 5.3.10, 5.3.11, and 5.3.12, no discernible adverse impacts to land and visual resources, infrastructure, geology and soils, biological and ecological resources, waste generation, noise, or socioeconomics are anticipated under the No Action Alternative. Thus, no disproportionately high and adverse impacts to minority or low-income communities are anticipated for these resource areas. The small potential impacts to geology and soils would be further reduced through the ER Project (see Section 5.3.3).

The city of Albuquerque's water supply system operates by interconnecting all areas of the city. The overlapping capability means the entire population shares impacts to the aquifer equally regardless of the location of a specific community. Impacts to the basin-wide aquifer are dominated by the city of Albuquerque (including citizens, businesses, and nonbusiness entities) by a 70 to 1 ratio with respect to SNL/NM. A localized impact of aquifer drawdown occurs as a result of SNL/NM operations; however, the local communities dominate this impact (see Section 5.3.4). Because the potential adverse impact from SNL/NM operations affects all communities equally, no disproportionately high and adverse impacts to minority or low-income communities are anticipated for this resource area.

As discussed in Section 5.3.6, the potential for impacts to cultural resources from explosive test debris, off-road vehicle traffic, and unintended fires would be minimal. Continued SNL/NM security would likely result in a positive impact on the resources, as archaeological sites remain protected. As a result of the ongoing consultation with 15 Native American tribes, no TCPs have been identified at SNL/NM; however, several tribes have requested that they be consulted under the *Native American Graves Protection and Repatriation Act* (NAGPRA) if human remains are discovered within the ROI. These consultations will continue. If specific TCPs are identified, any impacts of SNL/NM activities on the TCP and any impacts of restricting access to the TCP would be determined in consultation with Native American tribes and further NEPA review would be conducted, if appropriate.

The concentrations of chemical contaminants from air emissions and the dose to the ROI from radiological air emissions would be below regulatory standards and human health guidelines. The potential impacts to nonradiological air quality and radiological air quality would be minimal (see Sections 5.3.7.1 and 5.3.7.2). Thus, no disproportionately high and adverse impacts to minority or low-income communities would be anticipated for this resource area.

As presented in Section 5.3.8, SNL/NM operations would have minimal potential to adversely affect human health for offsite residents or onsite workers. Thus, no disproportionately high and adverse impacts to minority or low-income communities would be anticipated for this resource area.

As shown in Section 5.3.9, impacts to public health from transporting materials and waste to offsite facilities would be estimated to be 0.1 excess LCFs per year from incident-free transportation and 0.65 deaths or injuries per year from transportation accidents. Transportation along Gibson, Louisiana, Wyoming, and Eubank Boulevards includes low-income and minority neighborhoods. According to the April 1997 Sandia Report *Addressing Environmental Justice Under the National Environmental Policy Act at Sandia National Laboratories/New Mexico* (SNL 1997f), five block groups located near KAFB gates have high potential for environmental justice-related impacts. Four of these block groups lie between Louisiana and Wyoming Boulevards south of Central (see Figure 4.15–3). No disproportionately high and adverse impacts to minority or low-income communities would be anticipated for this resource area.

Based on the analyses of all the resource areas and topic areas, impacts that would result during the course of normal operations would not pose disproportionately high and adverse health or environmental impacts on minority and low-income populations. Table 5.3.13–1 provides a brief summary of potential impacts to each resource or topic area.

Table 5.3.13–1. Summary of Potential Environmental Justice Impacts Under the No Action Alternative

RESOURCE OR TOPIC AREA	SUMMARIZED EFFECT	EFFECT ON RESOURCE OR TOPIC AREA ROI	PROPORTIONAL EFFECT ON	
			LOW -INCOME	MINORITY NEIGHBORHOODS
Land Use and Visual Resources	No changes in land use; minor changes in developed areas of SNL/NM	Not adverse	Not adverse	Not adverse
Infrastructure	All projected activities within capacities of existing road and utility systems	Not adverse	Not adverse	Not adverse
Geology and Soils	SNL/NM activities are not anticipated to destabilize slopes. Minimal deposition of contaminants to soils and continued removal of existing contaminants under the ER Program	Not adverse	Not adverse	Not adverse
Water Resources and Hydrology	SNL/NM groundwater use is projected to account for 11% of local aquifer drawdown.	Adverse	Not adverse	Not adverse
Biological and Ecological Resources	No significant adverse impacts are projected for biological and ecological resources.	Not adverse	Not adverse	Not adverse
Cultural Resources	Explosive testing debris, off-road vehicle traffic, and unintended fires would present a low potential for impacts.	Not adverse	Not adverse	Not adverse
Air Quality–Nonradiological Air	Emissions would be below the most stringent standards, which define the pollutant concentrations below which there are no adverse impacts to human health and the environment. Concentrations would be below regulatory standards and human health guidelines. SNL/NM carbon monoxide emissions would account for 5.7% of Bernalillo county carbon monoxide emissions.	Not adverse	Not adverse	Not adverse
Air Quality–Radiological Air	MEI: 0.15 mrem/yr Collective ROI dose: 5.0 person-rem/yr Average collective ROI dose: 6.8×10^{-3} mrem/yr	Not adverse	Not adverse	Not adverse

Table 5.3.13–1. Summary of Potential Environmental Justice Impacts Under the No Action Alternative (concluded)

RESOURCE OR TOPIC AREA	SUMMARIZED EFFECT	EFFECT ON RESOURCE OR TOPIC AREA ROI	PROPORTIONAL EFFECT ON	
			LOW -INCOME	MINORITY NEIGHBORHOODS
Human Health and Worker Safety	MEI lifetime risk of fatal cancer increases by 7.5×10^{-8} 2.5×10^{-3} fatal cancers (additional ROI)/yr Risk of cancer fatality to workforce is 6.8×10^{-3}	Not adverse	Not adverse	Not adverse
Transportation	Total annual material shipments: 5,096 Total KAFB traffic (daily vehicles): 38,406 Incident-free exposure, truck emissions - annual LCFs: 2.4×10^{-2} Incident-free exposure, dose - annual LCFs: 0.1	Not adverse	Not adverse	Not adverse
Waste Generation	All waste projections within capacities of existing waste management operations	Not adverse	Not adverse	Not adverse
Noise and Vibration	Effects would be limited to windows rattling or "startle reaction." Background noise levels would continue at current levels from generators, air conditioners, and ventilation systems, but increase due to additional vehicular traffic, aircraft noise, and temporary construction projects (range from 50 to 70 dB).	Not adverse	Not adverse	Not adverse
Socioeconomics	SNL/NM employees: 8,035 SNL/NM total economic activity: $4.13 B/yr Percent of ROI total economic activity: 9.7%	Not adverse[a]	Not adverse	Not adverse

Source: Original
B: billion
dB: decibel
ER: environmental restoration
LCF: latent cancer fatality
MEI: maximally exposed individual
mrem: millirem
ROI: region of influence
SNL/NM: Sandia National Laboratories/New Mexico
yr: year
[a] SNL/NM represents approximately 10 percent of the total economic activity in the ROI.

5.4 EXPANDED OPERATIONS ALTERNATIVE AND PREFERRED ALTERNATIVE

Under the Expanded Operations Alternative (the DOE's Preferred Alternative), DOE and interagency programs and activities at SNL/NM would increase to the highest reasonable activity levels that current facilities could support.

The DOE did not present a Preferred Alternative in the Draft SNL/NM SWEIS. The DOE has now selected the Expanded Operations Alternative exclusive of the MESA Complex as its Preferred Alternative. Under the Expanded Operations Alternative, the DOE would expand operations at SNL/NM as the need arose, subject to the availability of congressional appropriations, to increase the level of existing operations to the highest reasonable foreseeable activity levels that are analyzed in the SWEIS. The Preferred Alternative would only implement expansion at the existing MDL facility, without addition of the MESA Complex.

5.4.1 Land Use and Visual Resources

The implementation of the Expanded Operations Alternative would not affect existing land use patterns or visual resources at SNL/NM facilities on KAFB. If implemented, the MESA Complex configuration would have a negligible effect on land or visual resources because the Complex would be built on land owned by the DOE in TA-I, and the land is already well developed with structures of common scenic quality. Sections 5.4.1.1 and 5.4.1.2 discuss these resource areas in relation to the Expanded Operations Alternative.

5.4.1.1 Land Use

Under the Expanded Operations Alternative, there would be no additional impacts to existing land resources on KAFB. The extent of DOE land and USAF-permitted acreage currently available for use by SNL/NM facilities on KAFB would remain the same. Similarly, operations would remain consistent with industrial/research park uses and would have no foreseeable effects on established land-use patterns or requirements. Any new SNL/NM facilities, upgrades, and other actions associated with this alternative would not require changes to current land ownership or classification status because these activities would take place in or near existing facilities, within previously disturbed or developed areas, or on land already under DOE control. SNL/NM does not anticipate a need for additional land at testing sites on permitted or withdrawn areas in association with this alternative. At locations on permitted land where operations would be declining or shut down by the "owning" organization, SNL/NM would continue to hold the sites to conduct periodic safety checks and complete any environmental restoration actions (Section 5.3.3.1). Before the land could be returned to the USAF, SNL/NM would be responsible for conducting any demolition work and restoring the land to its condition when originally acquired (SNL 1997a).

5.4.1.2 Visual Resources

No additional impacts to visual resources are anticipated that would adversely change the overall appearance of the existing landscape, obscure views, or alter the visibility of SNL/NM structures. Any new facilities, expansions, and upgrades would be planned at or near existing facilities and in areas with common scenic quality. The efforts initiated by SNL/NM to incorporate campus-style design would continue. This style contains established principles and design guidance that provide a framework for the physical development and redevelopment of SNL/NM sites. The guidance covers building massing, facades, colors, building orientation and entries, traffic circulation corridors, standardized signage, and landscaping, including low-water-use plant selections. These efforts would be consistent with the high concern for scenery due to the number of observers and users in the area.

Based on increased operational levels associated under the Expanded Operations Alternative, activities at outdoor testing facilities in the Coyote Test Field and the Withdrawn Area would increase; however, there would be no development at these areas that would alter existing visual resources. Some testing activities that produce smoke and dust of variable quantity and duration would take place, but these conditions would be periodic and short-term and would not change the visual characteristics of the area. Where decommissioning, demolition, or ER work are planned, actions would be taken such as backfilling, reducing sideslopes, applying topsoil, reseeding, and establishing plant growth to restore the area to its condition when originally acquired by SNL/NM.

5.4.2 Infrastructure

As discussed in Section 5.3.2, the infrastructure analysis looked for potential incremental changes to SNL/NM services, utilities, and facilities by alternative. The two areas where incremental changes were identified are site-wide utility demands and four selected infrastructure facilities, including the steam plant, RMWMF, HWMF, and TTF. See Section 2.3 for a discussion of how the four infrastructure facilities were selected.

With regard to site-wide utility demands, most SNL/NM facilities do not meter utility use. For the Expanded Operations Alternative, the highest number reported under the No Action Alternative was used as the basis for projecting utility use. Any incremental changes from the base year and Expanded Operations Alternative projections in utility demands for the selected facilities (see Chapter 2) were taken into account by adjusting site-wide demand accordingly, as presented in Table 5.4.2–1. Facility-specific utility data are presented in Chapter 3, Table 3.6–1.

If the MESA Complex configuration is implemented, the DOE expects water use and wastewater discharge to increase by 3.8 M gal per year (see Table 5.4.2–1 footnote). In addition, electricity use would increase by 6,400 MWh, and natural gas use would increase by 6.4 M ft^3 annually.

As discussed in Section 5.3.2, analysis of the selected infrastructure facilities relied on the projected throughput and operational capacities as presented in Table 5.4.2–2.

Implementation of the Expanded Operations Alternative would result in demands on infrastructure generally increasing over the next 10 years (Table 5.4.2–1). Annual consumption of water, electricity, natural gas, fuel oil, and propane would be consistent with recent historic levels (SNL/NM 1998c). Small fluctuations in projected utility consumption rates would occur due to annual changes in weather. Table 5.4.2–1 includes a 10-percent increase for water, wastewater, electricity, and natural gas to show that system capacity would not be adversely affected if actual consumption exceeded projected consumption. More than 35 percent of the KAFB capacity would remain available.

While the Expanded Operations Alternative projects an increase in water use, both the DOE and SNL/NM are committed to reducing water use by 30 percent based on 1996 water use (see Section 5.3.2). Under the Expanded Operations Alternative, the current infrastructure resources would be capable of accommodating SNL/NM facility requirements and no major additional infrastructure facilities are proposed to be built. Generally, infrastructure facilities' operational levels and levels of support activities are projected to remain consistent with recent historical support levels. Although accounted for, SNL/NM D&D programs would reduce overall impacts to SNL/NM infrastructure. Specific details on infrastructure systems are presented in the *1998 Sites Comprehensive Plan* (SNL 1997a). Additional details on water resources are provided in Section 5.4.4. Traffic-related impacts are presented in Section 5.4.9. KAFB utility usage is specifically discussed in Section 6.2.

Steam production would continue at 544 M lb per year, which represents 16 percent of capacity. A discussion on the steam distribution system production capacity is provided in Section 5.3.2.

The HWMF would manage approximately 214,000 kg of waste per year (Table 5.4.2–2). Annual waste management would increase to 2.7 M lb per year at the RMWMF. Additional capacity exists with the HWMF and RMWMF by adding more hours to the work schedule. The TTF would process wastes at recent historical levels. Small fluctuations would occur due to normal operations. Actual generation rates would likely decrease over the next 10 years due to ongoing waste minimization and waste avoidance efforts and improved efficiencies (SNL/NM 1997a). Projected waste generation rates and waste facilities are further discussed in Section 5.4.10. If implemented, the MESA Complex configuration would change the annual throughput at the HWMF by an additional 1,200 kg (see Table 5.4.2–2). The MESA Complex configuration would not change annual throughput for the Steam Plant, RMWMF, and TTF.

5.4.3 Geology and Soils

The implementation of the Expanded Operations Alternative would increase activities at SNL/NM, thereby increasing the potential for soil contamination, as described in Section 5.4.3.1. As with the No Action Alternative, there would be no increase in the likelihood of impacts to slope stability (Section 5.4.3.2).

5.4.3.1 Soil Contamination

Section 5.3.3 describes the methods used to evaluate soil contamination at SNL/NM. It focuses on near-surface (zero to 1 ft deep) soil contamination at SNL/NM sites, particularly those investigated for the ER Project. The DOE has committed to managing 162 of 182 ER sites as inactive; the remaining 20 sites are still listed active. Of concern to the DOE among these active sites are outdoor testing areas where normal operations or accidents could result in the deposition of contaminants on the ground surface.

The more frequently tests are undertaken, the greater the probability of an occurrence that results in soil contamination. The Expanded Operations Alternative

Table 5.4.2–1. Annual[a] SNL/NM Utility Usage (Plus 10%) and Capacities Under the Expanded Operations Alternative

RESOURCE/DATA SOURCE	BASE YEAR USAGE	EXPANDED OPERATIONS ALTERNATIVE ANNUAL USAGE	SYSTEM CAPACITY[b]	SNL/NM USAGE[c] AS PERCENT OF CAPACITY	OTHER KAFB USAGE AS PERCENT OF CAPACITY
WATER USE (PLUS 10%, see note)					
Site-Wide Demand[d]	440 M gal	440 M gal	2 B gal	22	32
Selected Facilities/ Facility Groups[e]	0 M gal	55 M gal	NA		
TOTAL	**440 M gal**	**495 M gal (545 M gal)**	**2 B gal**	**25 (27)**	**32**
WASTEWATER DISCHARGE (PLUS 10%)					
Site-Wide Demand[d]	280 M gal	280 M gal	850 M gal	33	25
Selected Facilities/ Facility Groups[e]	0 M gal	41.6 M gal	NA		
TOTAL	**280 M gal**	**322 M gal (354 M gal)**	**850 M gal**	**38 (42)**	**25**
ELECTRICAL USE (PLUS 10%)					
Site-Wide Demand[d]	197,000 MWh	197,000 MWh	1,095,000[f] MWh	18	28
Selected Facilities/ Facility Groups[e]	0 MWh	525 MWh	NA		
TOTAL	**197,000 MWh**	**198,000 MWh (218,000 MWh)**	**1,095,000[f] MWh**	**18 (20)**	**28**
NATURAL GAS USE (PLUS 10%)					
Site-Wide Demand[d,g]	475 M ft^3	475 M ft^3	2.3 B ft^3	21	31
Selected Facilities/ Facility Groups[e,h]	0 M ft^3	0 M ft^3	NA		
TOTAL	**475 M ft^3**	**475 M ft^3 (522.5*M ft^3)**	**2.3 B ft^3**	**22 (24)**	**31**
MISCELLANEOUS					
Fuel Oil[h,i,j]	7,000 gal	7,000 gal	Not limited by infrastructure	NA	NA
Propane[h,j]	383,000 gal	383,000 gal	Not limited by infrastructure	NA	NA

Sources: SNL 1997a; SNL/NM 1998a, c; USAF 1998a, 1997b
B: billion
ft^3: cubic feet
FY: fiscal year
gal: gallon
M: million
MW: megawatt
MWh: megawatt hour

Table 5.4.2–1. Annual[a] SNL/NM Utility Usage (Plus 10%) and Capacities Under the Expanded Operations Alternative (concluded)

MESA: Microsystems and Engineering Sciences Applications
NA: Not applicable
psi: pounds per square inch
[a] Base Year is 1996 or 1997, the most representative of usage. Not necessarily the same as in Chapter 4. Although not accounted for in the table, SNL/NM expects to reduce water usage by approximately 30 percent by 2004 (see Table 5.3.2–1 for conservation-based scenario).
[b] Capacity means the actual or calculated maximum amount of water, wastewater, or other resource that can be used, discharged, or consumed.
[c] Usage means the annual actual or calculated amount of water, wastewater, or other resource used, discharged, or consumed.
[d] Prorated based on the following square footage: Base Year = 5.266 M; FY 2003 = 5.143 M; FY 2008 = 4.986 M
[e] Adjustment for contribution from selected facilities/facility groups as reported in SNL/NM 1998a. With the addition of MESA, water use would increase by 3.8 M gal per year, wastewater discharge would increase by 3.8 M gal per year, electricity use would increase by 6,400 MWh per year, and natural gas use would increase by 6.4 M ft3.
[f] Based on 125-MW rating
[g] Estimated based on 60 psi
[h] No adjustments were reported in SNL/NM 1998a
[i] Fuel oil is used in emergency situations at the steam plant and is not dependent upon square footage.
[j] Not expected to increase due to MESA.
Note: Ten percent was added to show that system capabilities are more than adequate.

Table 5.4.2–2. Selected (Infrastructure) Facility Annual Throughput[a] and Capacities Under the Expanded Operations Alternative

FACILITY[d]	BASE YEAR ANNUAL 1997	EXPANDED OPERATIONS ANNUAL THROUGHPUT	FACILITY CAPACITY ANNUAL	THROUGHPUT AS PERCENT OF CAPACITY
Steam Plant (Steam Produced)[e]	544 M lb	544 M lb	3.33 B lb[b]	16
HWMF (Waste Handled)[e]	203,000 kg	214,000 kg (w ith MESA 215,200 kg)	579,000 kg[c]	38
RMWMF (Waste Handled)[e]	1.6 M lb	2.7 M lb	2.7 M lb	100
TTF (Waste Handled)[e]	Minimal	1,200 lb	7,300 lb[b]	16

Sources: SNL/NM 1998a
B: billion
ft^3: cubic feet
HWMF: Hazardous Waste Management Facility
kg: kilogram
lb: pound
M: million
RMWMF: Radioactive and Mixed Waste Management Facility
TTF: Thermal Treatment Facility
[a] Throughput means the amount of steam produced or waste handled.
[b] Permit capacity
[c] This is the capacity for single-shift work with current employment level, not permit capacity.
[d] See Section 2.3 for a discussion on how these facilities were selected.
[e] See Table 3.6–1, "Infrastructure" category
Note: If implemented, the MESA Complex configuration would not change Steam Plant, RMWMF, and TTF annual throughput.

would increase the likelihood of soil contamination over the No Action Alternative. The number of Lurance Canyon certification burn tests, for example, would increase from 12 to 55 per year. Accordingly, the once in 10 years event, which would require decontamination and cleanup of up to 7,000 µg of DU per g of soil over a 1,000-ft^2 area, might be expected to occur once every 2 years. SNL/NM conducts immediate cleanup actions (SNL/NM 1998a) and periodic site surveys (SNL 1997e) to clean up these sites to levels that meet future land use standards.

5.4.3.2 Slope Stability

Section 5.3.3 describes the relevance of and methods used to evaluate slope stability. Four areas were selected for a detailed, qualitative evaluation: the southern boundary of TA-IV, the Aerial Cable Facility, the Lurance Canyon Burn Site, and the Electro-Explosive Research Facility. The likelihood of slope failure at these locations would be remote.

Under the Expanded Operations Alternative, no changes in activity types or frequencies would be projected for TA-IV and the Electro-Explosive Research Facility (SNL/NM 1998a). An increase in testing would be expected at the Aerial Cable Facility and the Lurance Canyon Burn Site, with some tests increasing by a factor of five over 1996 levels (SNL/NM 1998a). No slope destabilizing activities have been identified at the Lurance Canyon Burn Site. Accidental burns of vegetation from hot missile debris could become more frequent at the Aerial Cable Facility. This could cause a decrease in vegetation cover. However, this area is mostly bedrock with a thin soil veneer, and no evidence of slope instability was observed in a previously burned area. Therefore, no effect on slope stability would be projected under the Expanded Operations Alternative, with the likelihood of slope failure continuing to remain remote.

If implemented, the MESA Complex configuration would have a negligible effect on geology and soil resources. The facility would be constructed in a heavily developed area on disturbed land that currently contains buildings and structures. The complex would be built to UBC standards.

5.4.4 Water Resources and Hydrology

Impacts from the implementation of the Expanded Operations Alternative would not differ substantively from impacts described in Section 5.3.4 for the No Action Alternative. Impacts to groundwater quality and quantity and surface water quality and quantity are described in Sections 5.4.4.1, 5.4.4.2, 5.4.4.3, and 5.4.4.4, respectively.

5.4.4.1 Groundwater Quality

Section 5.3.4 identifies sources of groundwater contamination and presents modeling of the CWL. All groundwater quality impacts described in Section 5.3.4.1 are alternative-independent—the Expanded Operations Alternative would not cause any change in the nature or extent of groundwater contamination. Contamination of groundwater would remain an adverse impact as discussed in Section 5.3.4.1. No changes in rate and scope of ER Project remediation activities are projected for the Expanded Operations Alternative.

5.4.4.2 Groundwater Quantity

Under the Expanded Operations Alternative, using the groundwater quantity analysis described in Section 5.3.4.2 and projected SNL/NM water use for 1998 to 2008, 628 M ft^3 of water would be withdrawn over the 10-year operational period in comparison with 605 M ft^3 under the No Action Alternative. Under the Expanded Operations Alternative, this amount would account for approximately 12 percent of the 5,384 M ft^3 of groundwater withdrawal in the vicinity of KAFB from 1998 to 2008, compared to 11 percent under the No Action Alternative. If the MESA Complex configuration is implemented, an additional 7 M ft^3 (or 635 M ft^3) of water would be withdrawn over the 10-year operational period. This would increase groundwater withdrawal in the vicinity of KAFB by 0.1 percent. The total usage would contribute approximately 3 ft to local aquifer drawdown over the 10-year period.

The impacts described in Section 5.3.4.2 would not vary in any significant manner under the Expanded Operations Alternative. Aquifer drawdown would remain an adverse impact.

5.4.4.3 Surface Water Quality

SNL/NM impacts to surface water quality are discussed in Section 5.3.4. This discussion compares results of water quality analyses in Tijeras Arroyo (from samples collected during storm events), near the downstream boundary of KAFB, with NMWQCC stream standards. No constituents in the analyses exceeded these standards. Further, the three major potential contributors to surface water contamination (ER Project sites; permitted storm water discharges from TAs-I, -II, and -IV; and outdoor testing facilities) were evaluated based on potential contaminants and likelihood of migration.

Under the Expanded Operations Alternative, two changes could occur in the potential contributors to surface water contamination.

- A projected increase in staff of 10 percent over current levels (Section 5.4.12) could potentially add to the quantity of oil and grease runoff from permitted storm water discharges in TAs-I, -II, and -IV. The most recent storm water monitoring shows oil and grease concentrations ranging from 0.60 to 1.4 mg/L (SNL 1997d). Although there are no quantitative NPDES or state limits for oil and grease, these concentrations are near detection limits. A 10-percent increase in these values would have no discernible environmental consequence, especially considering dilution that would occur in Tijeras Arroyo during periods of runoff.

- An increase in the frequency of outdoor tests could result in an increase of radioactive materials deposited on the ground surface. Surface water sampling in Tijeras Arroyo has shown concentrations of radionuclides consistent with background levels. Only two outdoor testing sites, the Aerial Cable Facility and the Lurance Canyon Burn Site, have a defined path to Tijeras Arroyo. Some types of tests at both of these facilities would increase by a factor of five from the baseline year (1996) under the Expanded Operations Alternative. However, to date, surface water sampling has not shown evidence of contamination resulting from tests, and both sites are located at least 10 mi upstream of the point where Tijeras Arroyo exits KAFB. Therefore, concentrations of radionuclides at the exit point of Tijeras Arroyo from KAFB would be anticipated to remain the same under the Expanded Operations Alternative.

5.4.4.4 Surface Water Quantity

The method used to estimate the SNL/NM contribution to surface water quantity is described under the No Action Alternative (Section 5.3.4) and Appendix B. The analysis calculates the quantities of excess surface water runoff from developed areas of SNL/NM and the discharge of process and sanitary water to Albuquerque's Southside Water Reclamation Plant. Under the No Action Alternative, the estimated total excess surface water contribution to the Rio Grande would be between 40.7 and 41.3 M ft^3 annually. The vast majority of this contribution (40.6 M ft^3) would be from discharges to the water reclamation plant.

Storm Water Runoff

The Expanded Operations Alternative would result in only minor net differences in building and parking lot areas. These differences would not significantly change the developed (impervious) area of SNL/NM from the 0.72-mi^2 area projected under the No Action Alternative. Therefore, excess surface water runoff would continue at 100,000 to 700,000 ft^3 per year, as estimated under the No Action Alternative (Appendix B).

Discharge to Sanitary Sewer

The estimated annual volume of water to be discharged to the sanitary sewer under the Expanded Operations Alternative would be 43.0 M ft^3 (322 M gal), a 6 percent increase from the No Action Alternative (Section 5.3.4). Combined with the excess surface water runoff, the estimated total SNL/NM effect on surface water quantity would be between 43.1 and 43.7 M ft^3 annually. This would represent approximately 0.07 percent of Rio Grande flow at the discharge points. Under the Expanded Operations Alternative, no detrimental effects to the Rio Grande from the quantity of SNL/NM water discharged would be likely.

If implemented, the MESA Complex configuration would become operational after 2003 and the annual volume of water to be discharged to the sanitary sewer would increase by 0.4 M ft^3 (3 M gal). Combined with the excess surface water runoff, the estimated total SNL/NM effect on surface water quantity would increase by 0.4 M ft^3 (3 M gal).

5.4.5 Biological and Ecological Resources

Implementation of the Expanded Operations Alternative would result in impacts to biological and ecological resources similar to those under the No Action Alternative (see Section 5.3.5). There would be slightly increased levels of noise and activity under this alternative due to more frequent outdoor explosions. Impacts to biological and ecological resources would be minimal. Inventory and management of the biological resources by SNL/NM, KAFB, and the USFS would continue to protect the animals, plants, and sensitive species on KAFB.

Outdoor activities would have a slight increase in the probability of unintended fires, off-road vehicular traffic, noise, small explosive debris, and plumes of smoke. The increased level of activity would be unlikely to cause the loss of any known species or plant community at KAFB. The area of disturbed vegetation would be increased, but the effect on the viability of plant communities would be negligible.

If implemented, the MESA Complex configuration would have a negligible effect on biological and ecological resources. The MESA Complex would be constructed in a heavily developed area on disturbed land that currently contains structures. There are no known Federally listed species or areas designated as critical habitat in the proposed facility's area of influence.

There would be no effect to the Federally endangered peregrine falcon, as discussed in Section 5.3.5. It is not anticipated that there would be adverse effects to the viability of populations of any sensitive species.

Potential increases in contaminant loads due to increased operations affecting animals and plants would be negligible based on annual ecological monitoring data (SNL/NM 1997u). See Section 5.4.3 for a discussion of contaminant loads and geology and soils impacts.

5.4.6 Cultural Resources

The implementation of the Expanded Operations Alternative would have low to negligible impacts to cultural resources due to 1) the absence of cultural resource sites on DOE-administered land, 2) the nature of the cultural resources found in the ROI (see Appendix C), 3) compliance with applicable regulations and established procedures for the protection and conservation of cultural resources on lands administered by the DOE and on lands administered by other agencies and used by the DOE (see Section 4.8.3.2 and Chapter 7), and 4) the largely benign nature of SNL/NM activities near cultural resources. Implementation of the regulations and procedures would make impacts from construction, demolition, decontamination, renovation, or ER Project activities unlikely.

If implemented, the MESA Complex configuration would have a negligible effect on cultural resources. The MESA Complex would be constructed in a heavily developed area on disturbed land that currently contains structures. There are no known cultural resources, including prehistoric or historic archaeological sites or buildings, in or near the area to be disturbed. If implemented, the DOE would comply with applicable regulations for the protection and preservation of cultural resources in case any are encountered before or during construction.

Under the Expanded Operations Alternative, prehistoric and historic cultural resources could potentially be affected by activities performed at five SNL/NM facilities, although the potential for impact would be low to negligible. These facilities consist of the Aerial Cable Facility, Lurance Canyon Burn Site, Thunder Range, Sled Track Complex, and Terminal Ballistics Complex. The first three facilities are located on land not owned by the DOE. Impacts could potentially result from three activities at these facilities: production of explosive testing debris and shrapnel, off-road vehicle traffic, and unintended fires and fire suppression. An increase in the frequency of these activities under the Expanded Operations Alternative would not result in a change in the potential for impacts from the No Action Alternative–the potential would remain low to negligible.

Another source of potential impact derives from the restricted access present at KAFB and at individual SNL/NM facilities. Restriction of access to areas within the ROI would have positive effects on cultural resources themselves. Under the Expanded Operations Alternative, current security levels that restrict access would be maintained for KAFB in general and would increase in frequency for specific SNL/NM facilities during various activities. These added restrictions would result in an increased level of protection for cultural resources located within the ROI and especially within the facility secure zones.

5.4.7 Air Quality

The implementation of the Expanded Operations Alternative would result in the nonradiological and radiological impacts to air quality described in Sections 5.4.7.1 and 5.4.7.2, respectively. The methods used to calculate these impacts are similar to those used to calculate air quality impacts for the No Action Alternative (Section 5.3.7).

5.4.7.1 Nonradiological Air Quality

Criteria Pollutants

Impacts of criteria pollutant concentrations resulting from the Expanded Operations Alternative were estimated by modeling emission sources using the EPA *ISCST3* (dated 97363) model. The emission rates for the steam plant, which were used as input in the model, are the same as those presented under the No Action Alternative. It is estimated that this level of operation would be sufficient to supply steam to all facilities under the Expanded Operations Alternative because no additional floor space is anticipated. In addition to the steam plant emissions, emissions from the four 600-kw emergency generators in Building 862, the boiler and emergency generator in Building 701, and the 600-kw generator in Building 870b were used as input into the model.

The OLM was used to calculate the nitrogen dioxide concentration as was done under the No Action Alternative. Background concentrations of nitrogen dioxide from monitoring station 2ZR for the 24-hour average concentration and the annual average concentration of 0.029 ppm (46 $\mu g/m^3$) and 0.008 ppm (13 $\mu g/m^3$) respectively, were added to the modeled nitrogen dioxide concentrations. The resulting concentrations of criteria pollutants are estimated to be comparable to the No Action Alternative concentrations presented in Table 5.3.7–1. Criteria pollutant concentrations under the Expanded Operations Alternative would be below applicable Federal and New Mexico state standards.

Airborne particulate matter (for example, dirt and equipment emissions) levels would be elevated during construction. Fugitive dust generated during the cleaning, grading, and other earthmoving operations is dependent on a number of factors, which include silt and moisture content of the soil, wind speed, and area disturbed. These temporary increases are expected to be too small to result in violation of the NAAQS beyond the SNL/NM boundary.

Mobile Sources

Mobile source (motor vehicle) emissions under the Expanded Operations Alternative would include carbon monoxide emissions estimated from increased commuter traffic. The estimated commuter traffic would be 110 percent of that under the No Action Alternative, or 14,940 commuter vehicles and 660 on-base vehicles. The carbon monoxide emission factor was determined by the EPA mobile source emission factor model *MOBILE5a,* projected to 2005, and would be 28.5 g per mile (SNL 1996c).

The projected carbon monoxide emissions for SNL/NM under the Expanded Operations Alternative, based on the aforementioned assumptions and modeled emission factor, would be 3,837 tons per year. This represents an increase of 348 tons per year from the No Action Alternative; however, this still represents a decrease of 250 tons per year from the 1996 baseline (see Table D.1–30). Projected carbon monoxide emissions for Bernalillo county for 2005 are 206 tons per day, or 75,190 tons per year (AEHD 1998). The contribution of carbon monoxide emissions from vehicles commuting to and from SNL/NM and SNL/NM-operated on-base vehicles in 2005, as a percent of the total county highway mobile source carbon monoxide emissions, would be 5.1 percent.

Total carbon monoxide emissions are shown in Table 5.4.7–1. Estimates from construction activities are included and are the same as those described in Section 5.3.7.1 for the No Action Alternative.

Total carbon monoxide emissions for the Expanded Operations Alternative are 243 tons per year less than the 1996 baseline, well below the 100 tons per year incremental increase above baseline that would require a conformity determination. In addition, the total carbon monoxide emissions for the Expanded Operations Alternative were found to be approximately 3 percent of the maintenance area's emissions of carbon monoxide. As a result, the DOE has concluded that no conformity determination is required for the Expanded Operations Alternative.

Table 5.4.7–1. Carbon Monoxide Emissions (tons per year) from SNL/NM under the Expanded Operations Alternative

STATIONARY SOURCES	MOBILE SOURCES	CONSTRUCTION ACTIVITIES	BURN SITE	TOTAL
18.36[a]	3,837	132	4.5[b]	3,991.86

Source: SNL/NM 1998a, SNL 1996c
lb: pound
SNL/NM: Sandia National Laboratories/New Mexico
[a] Includes incremental carbon monoxide emissions from an "insignificant" boiler and emergency generator in Building 701 and a 600-kw capacity generator in Building 870b added between 1996 and 2008.
[b] Represents carbon monoxide emissions from combustion of 400,200 lb of JP-8 fuel.

Lurance Canyon Burn Site

Estimates of the criteria pollutant emissions under the Expanded Operations Alternative for the Lurance Canyon Burn Site were based on a reasonable upper bound quantity of JP-8 fuel burned (1,000 gal), which is equal to that used to estimate criteria pollutant emissions under the No Action Alternative. The frequency of tests is expected to increase for the Expanded Operations Alternative, therefore, increasing the throughput of JP-8 fuel burned for the year. The proposed operating permit limits for the Lurance Canyon Burn Site were based on the following fuel throughputs:

- 36,000 lb of sawdust or wood
- 12,000 lb for a sawdust-propellant-acetone mixture
- 400,200 lb of JP-8 fuel
- 14,400 lb of urethane foam
- 100 lb of explosives

Concentrations of pollutants resulting from test emissions were calculated using the *OBODM* (Bjorklund et al. 1997). The results for the criteria pollutants are presented in Table 5.4.7–2 along with applicable Federal (40 CFR Part 50) and New Mexico state standards (20 NMAC 2.3) for each pollutant. The maximum percent of a criteria pollutant standard is 4.3 percent for the NMAAQS for the 24-hour average PM_{10}.

Table 5.4.7–2. Criteria Pollutant Concentrations from Lurance Canyon Burn Site with Applicable National and New Mexico Ambient Air Quality Standards Under the Expanded Operations Alternative

POLLUTANT	AVERAGE TIME	NAAQS (ppm[μg/m^3])	NMAAQS (ppm[μg/m^3])	EXPANDED OPERATIONS CONCENTRATION (ppm[μg/m^3])	PERCENT OF STANDARD
Carbon Monoxide	8 hours	9[8,564]	8.7[8,279]	0.023[21.45]	< 1
	1 hour	35[33,305]	13.1[12,466]	0.18[171.6]	1.4
Nitrogen Dioxide	Annual	0.053[83]	0.05[78]	6.4×10^{-7}[0.001]	< 1
	24 hours	-	0.10[156]	1.18×10^{-4}[0.184]	< 1
PM_{10}[a]	Annual	50	-	0.018[b]	< 1
	24 hours	150	-	6.51[b]	4.3
Sulfur Dioxide	Annual	0.03[65]	0.02[44]	4.6×10^{-7}[0.001]	< 1
	24 hours	0.14[305]	0.10[218]	1.7×10^{-4}[0.367]	< 1
	3 hours	0.50[1,088]	-	0.001[2.94]	< 1
TSP[a]	Annual	-	60[b]	0.018[b]	< 1
	24 hours	-	150[b]	6.51[b]	4.3

Sources: 20 NMAC 2.3, 40 CFR 50, Bjorklund et al. 1997, SNL 1997a,
μg/m^3: micrograms per cubic meter
°R: degrees Rankin
ft: feet
NAAQS: National Ambient Air Quality Standards
NMAAQS: New Mexico Ambient Air Quality Standards
PM_{10}: particulate matter smaller than 10 microns in diameter
ppm: parts per million
TSP: total suspended particulates
[a] PM_{10} assumed equal to TSP
[b] μg/m^3
Note: The standards for some of the pollutants are stated in ppm. These values were converted to μg/m^3 with appropriate corrections for temperature (530° R) and pressure (elevation 5,400 ft) following New Mexico Dispersion Modeling Guidelines (NMAPCB 1996).

Eighty-nine chemical pollutants, resulting from the tests performed at the Lurance Canyon Burn Site, were also evaluated. Each of these pollutants was compared with the respective OEL/100 guideline and each comparison indicated the chemical concentrations would be below the guideline. Appendix D contains the list of chemical concentrations resulting from the estimated Expanded Operations Alternative tests at the Lurance Canyon Burn Site.

Noncarcinogenic Chemical Screening

Estimates of noncarcinogenic chemical emissions under the Expanded Operations Alternative were determined by extrapolating the No Action Alternative noncarcinogenic chemical emissions to the level of expanded operations for each of the selected facilities. The same screening process described for the No Action Alternative was performed to reduce the number of chemicals to those that exceed the screening level. The screening analysis considered those chemicals screened under the No Action Alternative from the same 12 facilities located in TAs-I, -II, -III, -IV, and -V and shown in Table 5.3.7–5. One noncarcinogenic chemical, chromium trioxide from Building 870, would exceed the screening level under the Expanded Operations Alternative.

Carcinogenic Chemical Screening

Carcinogenic chemical emissions under the Expanded Operations Alternative were determined by extrapolating the No Action Alternative carcinogenic chemical emissions to the level of expanded operations for each of the selected facilities. The same screening process described for the No Action Alternative was performed to reduce the number of carcinogenic chemicals to those that exceed the screening level. The screening analysis considered those chemicals screened under the No Action Alternative from the same 12 facilities in TAs-I, -II, -III, -IV, and -V and shown in Table 5.3.7–5. Ten carcinogenic chemicals from five facilities would exceed the screening level. Table 5.4.7–3 presents concentrations

Table 5.4.7–3. Annual Carcinogenic Chemical Concentrations from Facility Emissions Under the Expanded Operations Alternative

CHEMICALS EXCEEDING SCREENING LEVELS	BUILDING SOURCE	EXPANDED OPERATIONS CONCENTRATION (ppb[μg/m^3])
Chloroform (Trichloromethane)	6580	$1.09x10^{-3}$[$4.42x10^{-3}$]
Dichloromethane (Methylene Chloride)	870	$7.31x10^{-2}$[$2.11x10^{-1}$]
Dichloromethane (Methylene Chloride)	878	$3.53x10^{-3}$[$1.02x10^{-2}$]
Formaldehyde	878	$6.36x10^{-4}$[$6.49x10^{-4}$]
Trichloroethene	878	$1.16x10^{-2}$[$5.20x10^{-2}$]
1,2-Dichloroethane (Ethylene Dichloride)	893	$5.86x10^{-4}$[$1.97x10^{-3}$]
1,2-Dichloroethane (Ethylene Dichloride)	MESA	NA
1,4-Dichloro-2-Butene	897	$3.96x10^{-5}$[$1.68x10^{-4}$]
Acrylonitrile	897	$1.52x10^{-4}$[$2.74x10^{-4}$]
Chloroform (Trichloromethane)	897	$1.25x10^{-3}$[$5.07x10^{-3}$]
Trichloroethene	897	$1.58x10^{-3}$[$7.06x10^{-3}$]

Source: SNL/NM 1998a
MESA: Microsystems and Engineering Sciences Applications
NA: not applicable
ppb: parts per billion
μg/m^3: micrograms per cubic meter
Bldg. 6580 – Hot Cell Facility (HCF)
Bldg. 870 – Neutron Generator Facility (NGF)
Bldg. 878 – Advanced Manufacturing Processes Laboratory (AMPL)
Bldg. 893 – Compound Semiconductor Research Laboratory (CSRL)
Bldg. 897 – Integrated Materials Research Laboratory (IMRL)
[a] If implemented, the MESA Complex configuration would become operational after 2003, and CSRL operations would relocate to MESA. No new or additional carcinogenic chemicals would be associated with MESA emissions.

for carcinogenic chemicals with estimated emission rates greater than the screening level.

If implemented, the MESA Complex configuration would decrease the number of carcinogenic chemicals exceeding the screening level from 10 to 9. This would be a result of the replacement of the CSRL by the MESA Complex. For 1,2-dichloroethane, there would be no more emissions due to elimination of the chemical from the inventory, as noted in Table 5.4.7–3

Under the Expanded Operations Alternative, nonradiological air quality concentrations for criteria and chemical pollutants would be below regulatory standards and human health guidelines. Maximum concentrations of criteria pollutants from operation of the steam plant, electric power generator plant, boiler and emergency generator in Building 701, and 600-kw-capacity generator in Building 870b would represent a maximum of 96 percent of the allowable regulatory limit at a public access area. Noncarcinogenic chemicals that exceed the screening levels, based upon emission rates calculated from purchased quantities (Appendix D, Tables D.1–6, D.1–10, D.1–14, and D.1–18), do not exceed the screening levels based upon process engineering estimates of actual emission rates, with the exception of chromium trioxide from Building 870 (Appendix D, Table D.1–21). Further analysis of chromium trioxide is performed in Section 5.3.8 to determine human health impacts from noncarcinogenic chemical emissions from SNL/NM. The risk due to exposure of the 10 carcinogenic chemicals that exceed the carcinogenic chemical screening guidelines (Appendix D, Table D.1–25) are further evaluated in Section 5.4.8, Human Health and Worker Safety.

5.4.7.2 Radiological Air Quality

The SWEIS analysis reviewed the radiological emissions from all SNL/NM facilities. Section 4.9.2 identifies 17 SNL/NM facilities as producing radiological emissions. Based on historic SNL/NM radionuclide emissions data, NESHAP compliance reports, and the FSID (SNL/NM 1998ee), 10 of the 17 SNL/NM facilities were modeled for radiological impacts (Table 5.4.7–4). ACRR operations under DP configuration were assumed comparable to Annular Core Pulsed Reactor II (ACPR-II) operations, and, for the purpose of conservative analysis, the ACRR was evaluated under simultaneous operation of both configurations. For analysis purposes, based on the review of historical dose evaluations, other facilities that would not contribute more than 0.01 mrem/yr (0.1 percent of the NESHAP limit) to the MEI were screened from further consideration in the SWEIS. The modeled releases to the environment would result in a calculated dose to the MEI and the population within 50 mi of TA-V. TA-V was selected as a center for the population within a 50-mi radius, because the majority of radiological emissions would be from TA-V, specifically the HCF, and TA-V is historically addressed for annual SNL/NM NESHAP compliance (SNL/NM 1996u).

The *CAP88-PC* computer model (DOE 1997e) was used to calculate the doses. Details on the *CAP88-PC* model, radionuclide emissions, model and source parameters,

Table 5.4.7–4. Radiological Emissions from Sources at SNL/NM Under the Expanded Operations Alternative

FACILITY NAME	TECHNICAL AREA	RADIONUCLIDE[a]	RELEASE (Ci/yr)
Annular Core Pulsed Reactor (ACPR-II DP configuration), Building 6588	V	Argon-41	7.8
Annular Core Research Reactor (ACRR, medical isotopes production configuration), Building 6588	V	Argon-41 Tritium	2.2 2.2
Explosive Components Facility (ECF), Building 905	II	Tritium	$2.0x10^{-3}$
High-Energy Radiation Megavolt Electron Source (HERMES III), Building 970	IV	Nitrogen-13 Oxygen-15	$3.603x10^{-3}$ $3.603x10^{-4}$
Hot Cell Facility (HCF), Building 6580	V	Iodine-131 Iodine-132 Iodine-133 Iodine-134 Iodine-135 Krypton-83m Krypton-85 Krypton-85m Krypton-87 Krypton-88 Xenon-131m Xenon-133 Xenon-133m Xenon-135 Xenon-135m	3.90 10 18 0.72 11 660 0.63 970 190 1,600 5.9 7,200 340 6,900 1,200
Mixed Waste Landfill (MWL)	III	Tritium	0.29
Neutron Generator Facility (NGF), Building 870	I	Tritium	156
Radioactive and Mixed Waste Management Facility (RMWMF), Building 6920	III	Tritium	2.203[b]
Radiographic Integrated Test Stand (RITS), Building 970	IV	Nitrogen-13	0.16
Sandia Pulsed Reactor (SPR), Building 6590	V	Argon-41	30

Source: SNL/NM 1998a
DP: Defense Programs
Ci/yr: curies per year
SNL/CA: Sandia National Laboratories/California
[a] Radiological emissions are projections based on planned activities, projects, and programs. Radionuclide releases are not the same as those presented in Chapter 4.
[b] Because SNL/CA tritium-contaminated oil levels handled at RMWMF during the base year were abnormally high, this maximum level of emissions was assumed to be released in any year and, therefore, was constant for all alternatives.

exposures, meteorological data, and population data are presented in Appendix D. Figure 5.3.7–3 shows the locations of the 10 facilities modeled in the SWEIS. Table 5.4.7–4 presents the estimated radiological emissions from the 10 SNL/NM facilities under the Expanded Operations Alternative. The radiological emissions from each facility were estimated based on SNL/NM planned operations and tests projected into the future. Detailed information is available in the FSID (SNL/NM 1998ee). The emission of argon-41 from the ACRR, under the medical isotope production configuration, would be lower than during the base year, 1996, because of the refurbishing operations conducted during 1996. The SPR emissions were estimated to be higher than emissions during the base year. This is due to instituting NESHAP requirements for "confirmatory measurements" of radiological air emissions where measured emission factors were determined for both the SPR and the ACRR. These measured emission factors were found to be higher than the calculated emission factors. These measurements are source-specific to the SPR and ACRR and would not affect the calculations or measurements for other facilities.

Because the general public and USAF personnel have access to SNL/NM, 14 core receptor locations and 2 offsite receptor locations of public concern were considered for dose impact evaluations (see Appendix D.2). Based on NESHAP reports, 16 onsite and 6 offsite additional receptor locations were also evaluated. A total of 38 receptor locations were evaluated for dose impacts. The core receptor locations include schools, hospitals, a museum, and clubs, and were considered for analysis because of potential impacts to children, the sick, and the elderly. The 32 modeled onsite and core receptor locations are shown in Figure 5.3.7–4.

The dose to an individual at each receptor location and to the population within 50 mi from the radionuclide emission from each source were calculated using the *CAP88-PC* model. The public receptor receiving the maximum dose was identified as the MEI. The model-calculated dose contributions, including external, inhalation, and ingestion exposure pathways from each of the 10 sources, calculated individually at each receptor location, were combined at each modeled receptor to determine the overall SNL/NM site-wide normal operations dose to the MEI. Under the Expanded Operations Alternative, the maximum EDE to the MEI from all exposure pathways from all modeled sources was calculated to be 0.51 mrem/yr. The MEI having the highest combined dose would be located at the KUMMSC, north of TA-V. This location is consistent with the location of the MEI historically identified in the annual NESHAP compliance reports. The EDE contributions from these 10 sources to this combined MEI dose are presented in Table 5.4.7–5. Table 5.4.7–6 presents the doses at the 38 onsite, core, and offsite receptor locations. The potential doses for these additional locations would be much lower than the highest combined MEI dose. The total collective dose to the population of 732,523 within a 50-mi radius of TA-V was calculated to be 15.8 person-rem per year under the Expanded Operations Alternative. The contributions from all of the 10 modeled sources to the overall SNL/NM site-wide normal operations collective dose to the population within 50 mi are also presented in Table 5.4.7–4. The average dose to an individual in the population within 50 mi of TA-V (collective dose divided by the total population) would be 2.16×10^{-2} mrem/yr.

The calculated total MEI dose of 0.51 mrem/yr would be much lower than the regulatory limit of 10 mrem/yr to an MEI from SNL/NM site-wide total airborne releases of radiological materials (40 CFR Part 61). This dose would be small compared to an individual background radiation dose of 360 mrem/yr (see Figure 4.10–2). The calculated collective dose from SNL/NM operations to the population within 50 mi, 15.8 person-rem per year, would be much lower than the collective dose to the population from background radiation. Based on this individual background radiation dose, the population within 50 mi of TA-V would receive 263,700 person-rem per year.

Table 5.4.7–5. Summary of Dose Estimates from Radioactive Air Emissions to the SNL/NM Public Under the Expanded Operations Alternative

SOURCE	ANNUAL MEI DOSE, EDE (mrem)	ANNUAL POPULATION DOSE (person-rem)
Annular Core Pulsed Reactor II (ACPR-II) (DP configuration)	1.3×10^{-3}	2.16×10^{-2}
Annular Core Research Reactor (ACRR) (medical isotopes production configuration)	4.2×10^{-4}	1.07×10^{-2}
Explosive Components Facility (ECF)	9.9×10^{-9}	4.19×10^{-6}
High-Energy Radiation Megavolt Electron Source (HERMES III)	3.0×10^{-8}	6.06×10^{-7}
Hot Cell Facility (HCF)	5.0×10^{-1}	1.54×10^{1}
Mixed Waste Landfill (MWL)	4.0×10^{-6}	6.16×10^{-4}
Neutron Generator Facility (NGF)	7.4×10^{-4}	3.22×10^{-1}
Radioactive and Mixed Waste Management Facility (RMWMF)	7.5×10^{-6}	3.24×10^{-3}
Radiographic Integrated Test Stand (RITS)	1.3×10^{-6}	2.69×10^{-5}
Sandia Pulsed Reactor (SPR)	4.3×10^{-3}	8.01×10^{-2}
TOTAL MEI DOSE	**0.51**	**-**
50-MILE POPULATION COLLECTIVE DOSE	**-**	**15.8**

Sources: DOE 1997e, SNL/NM 1998a
DP: Defense Programs
EDE: effective dose equivalent
MEI: maximally exposed individual
mrem: millirem
rem: Roentgen equivalent, man
Note: Although the Annular Core Pulsed Reactor-II is expected to be operated under DP configuration intermittently, for this analysis, it was assumed to be operated simultaneously with the ACRR under medical isotopes production configuration. Its contribution to the total dose would not be appreciable. If implemented, the addition of the MESA Complex configuration would be unlikely to contribute radiological emissions.

Table 5.4.7–6. Summary of Dose Estimates from Radioactive Air Emissions to 38 Onsite and Offsite Receptors Under the Expanded Operations Alternative

RECEPTOR	ANNUAL RECEPTOR DOSE, EDE (mrem)
ONSITE AND NEAR-SITE RECEPTORS	
Albuquerque International Sunport (Bldg. 1064)	5.7×10^{-2}
Albuquerque International Sunport (Bldg. 760)	1.2×10^{-1}
Building 20706	7.8×10^{-2}
Building 24499	5.5×10^{-2}
Child Development Center-East	5.4×10^{-2}
Child Development Center-West	6.2×10^{-2}
Civil Engineering Research Facility (Bldg. 5701)	4.0×10^{-2}
Coronado Club	5.5×10^{-2}
Coyote Canyon Control Center	4.0×10^{-2}
Golf Course Clubhouse	2.3×10^{-2}
Golf Course Maintenance Area	1.5×10^{-1}
Kirtland Elementary School	6.1×10^{-2}
KAFB Firestation #4 (Bldg. 9002)	5.9×10^{-2}
KAFB Landfill	9.1×10^{-2}
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	5.1×10^{-1}
Loop Housing	5.3×10^{-2}
Lovelace Hospital	4.5×10^{-2}
Lovelace Respiratory Research Institute	4.2×10^{-2}
Manzano Offices (Fire Station)	1.1×10^{-1}
Maxwell Housing	7.2×10^{-2}
National Atomic Museum	6.9×10^{-2}
Pershing Park Housing	5.1×10^{-2}
Riding Stables	2.1×10^{-1}
Sandia Base Elementary	4.3×10^{-2}
Sandia Federal Credit Union	7.7×10^{-2}
Shandiin Day Care Center	6.3×10^{-2}
Technical Onsite Inspection Facility	9.8×10^{-2}
Veterans Affairs Medical Center	8.4×10^{-2}
Wherry Elementary School	5.2×10^{-2}
Zia Park Housing	6.6×10^{-2}

Table 5.4.7–6. Summary of Dose Estimates from Radioactive Air Emissions to 38 Onsite and Offsite Receptors Under the Expanded Operations Alternative (concluded)

RECEPTOR	ANNUAL RECEPTOR DOSE, EDE (mrem)
OFFSITE RECEPTORS	
Albuquerque City Offices	$1.5x10^{-1}$
East Resident	$5.8x10^{-2}$
Eubank Gate Area (Bldg. 8895)	$1.1x10^{-1}$
Four Hills Subdivision	$1.1x10^{-1}$
Isleta Gaming Palace	$6.6x10^{-2}$
Northeast Resident	$7.8x10^{-2}$
Seismic Center (USGS)	$6.8x10^{-2}$
Tijeras Arroyo (West)	$1.9x10^{-1}$

Sources: DOE 1997e, SNL/NM 1998a
EDE: effective dose equivalent
mrem: millirem
USGS: U.S. Geological Survey

5.4.8 Human Health and Worker Safety

Implementation of the Expanded Operations Alternative would result in the human health and worker safety impacts described in the following sections for normal operations and accident conditions.

5.4.8.1 Normal Operations

This section provides information on public health and worker health and safety under the Expanded Operations Alternative. It assesses the potential human health effects associated with routine releases of radioactive and nonradioactive hazardous material from SNL/NM normal operations. For detailed discussions of analytical methods and results, along with terminology, definitions, and descriptions, see Appendix E.

Health risk analyses are presented for potential exposures at specific receptor locations and for the potential maximum exposures to radiation and chemical air releases. For a description of receptor locations, exposure scenarios, and environmental pathways selected for assessing human health impacts, see Section 5.3.8.

Chemical Air Release Pathways

Under the Expanded Operations Alternative, chemical use would be more than the quantities projected under the No Action Alternative. As a result, air exposure concentrations at receptor locations are projected to increase slightly (Appendix E, Table E.3–3). The chemical assessment process, described in Section 5.3.8 for chemical air release pathways, identified seven COCs (see Appendix E, Table E.3–3). Three of the seven COCs are the same for different buildings. These COCs are associated with SNL/NM operations in Buildings 878 (AMPL), 893 (CSRL), 897 (IMRL), 6580 (HCF), and 870 (NGF).

If the CSRL were replaced by MESA Complex configuration, the number of COCs would decrease to six because there would no longer be emissions of 1,2-dichloroethane (see Table E.3–3).

Several receptor locations, individual exposure scenarios, and a hypothetical worst-case exposure scenario present the range of health risks from chemicals in the air in the SNL/NM vicinity. Adult, child, residential, and visitor risk assessments were calculated. Table 5.4.8–1 lists the human health impacts from the estimated exposures to chemical air releases from SNL/NM facility operations. These potential health risks are low and no adverse health effects would occur at these risk levels. Assessing the hypothetical worst-case exposure scenario establishes the upper bound value for health risk. Under the Expanded Alternative, the upper bound values for health risk from noncarcinogenic chemicals would be HIs of less than 1; the ELCRs would be less than 10^{-6} from carcinogenic chemicals (Table E.6–4). If implemented, the MESA Complex configuration would decrease chemical air emissions impacts by a small quantity.

Table 5.4.8–1. Human Health Impacts in the SNL/NM Vicinity from Chemical Air Emissions Under the Expanded Operations Alternative

RECEPTOR LOCATIONS	RECEPTOR	TOTAL HAZARD INDEX RME/AEI	TOTAL EXCESS LIFETIME CANCER RISK RME/AEI (WITH MESA)
RESIDENTIAL SCENARIOS			
Four Hills Subdivision[a]	Adult	<0.01/<0.01	$2.1 \times 10^{-10}/1.3 \times 10^{-10}$
	Child	<0.01/<0.01	$8.5 \times 10^{-11}/8.5 \times 10^{-11}$
Isleta Gaming Palace	Adult	<0.01/<0.01	$4.6 \times 10^{-10}/4.7 \times 10^{-12}$ ($4.3 \times 10^{-10}/4.4 \times 10^{-12}$)
	Child	<0.01/<0.01	$3.2 \times 10^{-10}/3.6 \times 10^{-12}$ ($3.0 \times 10^{-10}/3.4 \times 10^{-12}$)
KAFB Housing (Zia Park Housing)	Adult	<0.01/<0.01	$8.1 \times 10^{-10}/8.4 \times 10^{-12}$ ($7.2 \times 10^{-10}/7.4 \times 10^{-12}$)
	Child	<0.01/<0.01	$5.7 \times 10^{-10}/6.4 \times 10^{-12}$ ($5.0 \times 10^{-10}/5.7 \times 10^{-12}$)
VISITOR SCENARIOS			
Child Development Center-East	Child	<0.01/<0.01	$5.5 \times 10^{-10}/6.2 \times 10^{-12}$ ($5.0 \times 10^{-10}/5.6 \times 10^{-12}$)
Child Development Center-West	Child	<0.01/<0.01	$1.2 \times 10^{-10}/1.4 \times 10^{-12}$ ($1.1 \times 10^{-10}/1.3 \times 10^{-12}$)
Coronado Club	Adult	<0.01/<0.01	$1.2 \times 10^{-9}/1.3 \times 10^{-11}$ ($8.8 \times 10^{-10}/9.0 \times 10^{-12}$)
	Child	<0.01/<0.01	$7.0 \times 10^{-10}/7.8 \times 10^{-12}$ ($6.1 \times 10^{-10}/6.9 \times 10^{-12}$)
Golf Course (Club House)	Adult	<0.01/<0.01	$5.1 \times 10^{-10}/5.3 \times 10^{-12}$ ($4.8 \times 10^{-10}/4.9 \times 10^{-12}$)
Kirtland Elementary School	Child	<0.01/<0.01	$4.7 \times 10^{-11}/5.2 \times 10^{-13}$ ($3.5 \times 10^{-11}/3.9 \times 10^{-13}$)
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)[b]	Adult	<0.01/<0.01	$3.5 \times 10^{-10}/3.7 \times 10^{-12}$ ($3.3 \times 10^{-10}/3.4 \times 10^{-12}$)
Lovelace Hospital	Adult	<0.01/<0.01	$2.8 \times 10^{-10}/2.9 \times 10^{-12}$ ($2.5 \times 10^{-10}/2.6 \times 10^{-12}$)
	Child	<0.01/<0.01	$1.9 \times 10^{-10}/2.2 \times 10^{-12}$ ($1.8 \times 10^{-10}/2.0 \times 10^{-12}$)
National Atomic Museum	Adult	<0.01/<0.01	$2.1 \times 10^{-9}/2.1 \times 10^{-11}$ ($1.7 \times 10^{-9}/1.8 \times 10^{-11}$)
	Child	<0.01/<0.01	$1.4 \times 10^{-9}/1.6 \times 10^{-11}$ ($1.2 \times 10^{-9}/1.4 \times 10^{-11}$)
Riding Stables	Adult	<0.01/<0.01	$3.0 \times 10^{-10}/3.1 \times 10^{-12}$ ($2.8 \times 10^{-10}/2.9 \times 10^{-12}$)

Table 5.4.8–1. Human Health Impacts in the SNL/NM Vicinity from Chemical Air Emissions Under the Expanded Operations Alternative (concluded)

RECEPTOR LOCATIONS	RECEPTOR	TOTAL HAZARD INDEX RME/AEI	TOTAL EXCESS LIFETIME CANCER RISK RME/AEI (WITH MESA)
Sandia Base Elementary School	Child	<0.01/<0.01	$6.3\times10^{-10}/7.2\times10^{-12}$ ($5.8\times10^{-10}/6.5\times10^{-12}$)
Shandiin Day Care Center	Child	<0.01/<0.01	$8.2\times10^{-10}/9.3\times10^{-12}$ ($7.1\times10^{-10}/8.0\times10^{-12}$)
Veterans Affairs Medical Center	Adult	<0.01/<0.01	$3.4\times10^{-10}/3.5\times10^{-12}$ ($3.0\times10^{-10}/3.1\times10^{-12}$)
Wherry Elementary	Child	<0.01/<0.01	$4.2\times10^{-10}/4.7\times10^{-12}$ ($3.7\times10^{-10}/4.2\times10^{-12}$)

Source: SmartRISK 1996
MESA: Microsystems and Engineering Sciences Applications
RME: Reasonable maximum exposed
AEI: Average exposed individual

[a] Four Hills Subdivision receptor location impacts were based on Lurance Canyon Burn Site open burning air emissions, not SNL/NM building air emissions; therefore, no change would be due to MESA Complex configuration.
[b] This receptor location was analyzed using a worker scenario, as discussed in Appendix E.5
Note: See Section 5.3.8 for a discussion of selection of receptor locations.

Radiation Air Release Pathways

Projected air releases of radionuclides under the Expanded Operations Alternative would result in slightly higher radiation exposures to both the potential MEI and the population in the ROI. The maximum radiation doses calculated are presented in Section 5.4.7.2. The risk estimator of 500 fatal cancers per 1 M person-rem to the public was used to convert dose to fatal cancer risk. The maximum annual exposure dose resulting from SNL/NM sources would occur in the KAFB boundary at the KUMMSC and would increase the MEI's lifetime risk of fatal cancer by 2.6×10^{-7}. In other words, the likelihood of the MEI developing fatal cancer from a 1-year dose from SNL/NM operations would be less than 1 chance in 4 M. The annual collective dose to the population due to these releases would increase the number of fatal cancers in the entire population within the ROI by 7.9×10^{-3}. This value is less than 1; therefore, no LCFs would be likely to occur in the ROI population due to SNL/NM radiological air releases.

To estimate a range in the potential for human health effects, radiation doses were calculated at specific receptor locations in the SNL/NM vicinity and are presented in Table 5.4.7–6. Table 5.4.8–2 lists the associated radiological health risks to receptors at several of these locations. Receptors at most of these locations would have a considerably lower risk than the highest lifetime risk determined for the potential onsite MEI at the KUMMSC.

Receptors in the SNL/NM vicinity also have the potential to be exposed to air releases of radionuclides by way of the indirect air pathway: ingesting food that contains radionuclides. *CAP88-PC* integrates doses from this pathway in the collective dose estimation for the population within the ROI, but does not integrate it into the dose evaluation for the potential onsite MEI receptor. The estimated percentage of the population dose from ingesting potentially contaminated food would be approximately 10 percent (1.62 person-rem of the 15.8 person-rem annual collective population dose), which means it would also account for approximately 10 percent of the health risk value. When the same percent contribution is assumed, the lifetime risk of fatal cancer to the MEI from a 1-year dose would be increased by 2.6×10^{-8} (10 percent). The overall cancer risk to the MEI from radiation would still remain less than 1 chance in 4 M.

Nonfatal Cancers and Genetic Disorders

Radiation exposures can cause nonfatal cancers and genetic disorders. The NCRP has adopted risk estimators recommended by the ICRP for the public for assessing these health effects from radiation (ICRP 1991). The SNL/NM maximum annual dose to the MEI would increase the lifetime risk of nonfatal cancers and genetic disorders by 5.1×10^{-8} and 6.6×10^{-8}, respectively, which would be less than 1 chance in 15 M. The SNL/NM annual collective radiation dose to the population within the ROI would increase the number of nonfatal cancers

Table 5.4.8–2. Human Health Impacts in the SNL/NM Vicinity from Radiological Air Emissions Under the Expanded Operations Alternative

RECEPTOR LOCATIONS	LIFETIME RISK OF FATAL CANCER FROM A 1-YEAR DOSE
Child Development Center-East	2.7×10^{-8}
Child Development Center-West	3.1×10^{-8}
Coronado Club	2.8×10^{-8}
Four Hills Subdivision	5.5×10^{-8}
Golf Course (Club House)	1.2×10^{-7}
Kirtland Elementary School	3.1×10^{-8}
KAFB Housing (Zia Park Housing)	3.3×10^{-8}
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)[a]	2.6×10^{-7}
Lovelace Hospital	2.3×10^{-8}
National Atomic Museum	3.5×10^{-8}
Riding Stables	1.1×10^{-7}
Sandia Base Elementary School	2.2×10^{-8}
Shandiin Day Care Center	3.2×10^{-8}
Isleta Gaming Palace	3.3×10^{-8}
Veterans Affairs Medical Center	4.2×10^{-8}
Wherry Elementary School	2.6×10^{-8}

Sources: DOE 1997e, SNL/NM 1998a
MEI: maximally exposed individual

[a] The radiological MEI location for normal operations.
Note: Calculations were completed using *CAP88-PC*

and genetic disorders by 1.6×10^{-3} and 2.1×10^{-3}, respectively. This means that no additional nonfatal cancers or genetic disorders would be likely to occur within the ROI population from SNL/NM radiological air releases.

Transportation

The potential human health risks and accident fatalities for transporting of various radiological materials for SNL/NM operations are discussed in Section 5.4.9. The radiological dose to the population along the route within the ROI was estimated by assuming that 10 percent of the total travel distance would occur within the ROI. Therefore, 10 percent of the total radiological dose (off link and on link), calculated for all radiological materials transport, would be considered as an additional human health impact to the population along the route within the ROI (see Appendix G). This percentage of the annual collective population dose from transportation activity would increase the ROI number of LCFs by 2.5×10^{-3}. Adding this to the number of LCFs associated with the annual collective population dose due to routine air releases would change the risk to 1.0×10^{-2}. In other words, no additional LCFs in the ROI would likely occur from SNL/NM radiological materials transportation activities.

Composite Cancer Risk

Annual radiation dose accumulates over the total number of years the person is exposed. The radiological MEI lifetime risk of fatal cancer following a 30-year exposure time would be 7.8×10^{-6}, or less than 1 chance in 128,000. Thirty years is consistent with the exposure used in calculating the lifetime chemical cancer risk. To assess a composite cancer risk capturing the greatest potential cancer risk from radiation exposure, the fatal cancer risk to the MEI and the chemical ELCR at the same location (KUMMSC) were summed. For the KUMMSC location, the contribution of risk from exposure to chemicals would not increase the risk from radiation exposure (the increased lifetime risk of fatal cancer would remain $7.8x10^{-6}$), and it was concluded that the majority of the risk would be from the potential exposure to radiation (see Table E.6–2).

To assess a composite cancer risk capturing the highest potential risk from chemicals, the upper bound risk value for cancer risk from chemicals, which assumes a hypothetical worst-case exposure scenario, was added to the radiological MEI (KUMMSC) cancer risk (see Table E.6–4). This is an implausible scenario used only to bound the analysis. The composite cancer risk would be $7.9x10^{-6}$. This would still be within the EPA's cancer risk range established for the protection of human health of 10^{-6} to 10^{-4} (40 CFR Part 300). This would be a risk of less than 1 chance in 126,000. The SNL/NM potential contribution (from potential exposures to chemicals and radiation) to an individual's lifetime cancer risk would be very low, considering that, overall in the U.S., men have a 1-in-2 lifetime risk of developing cancer and for women the risk is 1-in-3. Approximately 1 of every 4 deaths in the U.S. is from cancer (ACS 1997).

Worker Health and Safety

Under the Expanded Operations Alternative, worker safety impacts would vary only slightly from under the No Action Alternative. Impacts to the entire workforce were assessed based on a 10 percent increase in the worker population (see Section 5.4.12) and the assumption that the SNL/NM worker injury/illness rate per 100 workers would remain consistent with the 5-year average derived for 1992 through 1996. Impacts expected would be zero fatalities per year, approximately 326 nonfatal injuries/illnesses per year, an average of 47 mrem per year radiation dose (TEDE) to the radiation-badged worker, and 1 or 2 confirmed chemical exposures per year.

Routine air emissions evaluated for potential exposures to specific receptors in the SNL/NM vicinity would have the potential to impact noninvolved workers at SNL/NM. A noninvolved worker is not exposed to chemical or radiological work-related activities, but is potentially exposed because they work at SNL/NM in the vicinity of facility releases. Potential noninvolved worker exposures to airborne radiation were identified using the KUMMSC receptor location (Table 5.4.8–2). Potential noninvolved worker exposures to airborne chemicals were identified using a receptor location at the center of TA-I, near SNL/NM's chemical facility sources. Based on an exposure scenario for a worker, health risks from chemicals to the noninvolved worker would be below a HI of 1 and less than 10^{-6} for an ELCR (see Appendix E, Table E.6–4).

The risks of cancer fatality from the annual average individual worker dose, annual maximum worker dose, and annual workforce collective dose (to the radiation worker population) are shown in Table 5.4.8–3. Health risks from the annual average individual and annual maximum worker doses would remain constant for each alternative (based on the REMS database dose information for 1996) (see Appendix E, Section E.6.1.1). The ICRP risk estimator of 400 fatal cancers per 1 M person-rem among workers was used to convert dose to risk of LCF. The annual workforce collective dose would be associated with $7.6x10^{-3}$ additional fatal cancers for the entire radiation worker population (those working in radiation-designated areas). For assessment purposes, this would equate to no additional LCFs in the radiation worker population under the Expanded Operations Alternative.

Table 5.4.8–3. Radiation Doses (TEDE[a]) and Health Impacts to Workers from SNL/NM Operations Under the Expanded Operations Alternative

RADIATION WORKER DOSE RATES	RADIATION DOSE	RISK OF CANCER FATALITY FROM A 1-YEAR DOSE
Annual Average Individual Worker Dose	47[b] (mrem/year)	$1.9x10^{-5}$
Annual Maximum Worker Dose	845[b] (mrem/year)	$3.4x10^{-4}$
RADIATION WORKER DOSE RATES	**RADIATION DOSE**	**NUMBER OF LCFs**
Annual Workforce Collective Dose	19 (person-rem/year)	$7.6x10^{-3}$

Source: SNL/NM 1997k
LCFs: latent cancer fatalities
mrem/yr: millirems per year
rem: roentgen equivalent, man
TEDE: total effective dose equivalent
[a] Average measured TEDE means the collective TEDE divided by the number of individuals with a measured dose greater than 10 mrem.
[b] Annual average individual and annual maximum worker doses would be expected to remain consistent with the base year, 1996 (see Section 4.10).
Note: Because not all badged workers are radiation workers, "radiation workers" means those badges with greater than 10 mrem above background measurements used in the calculations.

Nonfatal Cancer and Genetic Disorders

The SNL/NM maximum annual dose to the radiation worker population would increase the number of nonfatal cancer and genetic disorders by 1.5×10^{-3}, based on the risk estimator of 80 health effects per 1 M person-rem used for both effects. In other words, no additional nonfatal cancers or genetic disorders would be likely to occur in the radiation worker population due to operations under the Expanded Operations Alternative.

Nonionizing Radiation

Sources of nonionizing radiant energy at SNL/NM include both laser and accelerator facilities. The SAs for the SNL/NM laser facilities report that the lasers are operated according to ANSI guidelines, which require that light paths are isolated from workers and from other equipment (SNL/NM 1996b). For accelerators that generate EMP and that could present a high-voltage hazard to personnel, ANSI guidelines require mitigation measures such as shielding to block high-voltage hazards from personnel and, during tests shots, exclude personnel from high-bay areas. Based on measurements from SNL/NM's pulsed power facilities, the EMP exposures to personnel outside the high-bay would be less than the American Conference of Governmental Industrial Hygienists (ACGIH) standard of 100 kV/m (SNL/NM 1996b). Therefore, routine high-voltage impacts to SNL/NM workers and the public would not occur.

5.4.8.2 Accidents

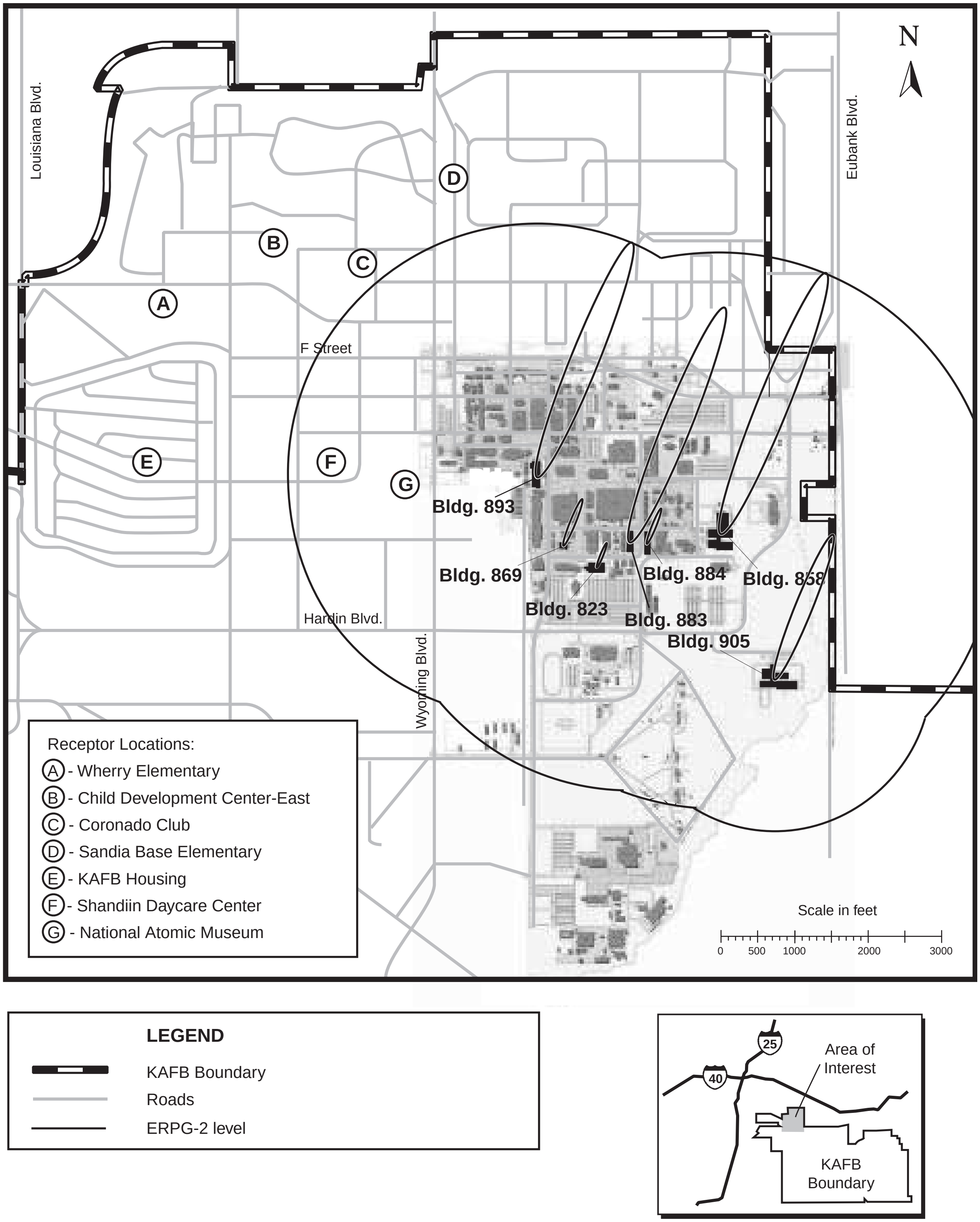
This section describes, under the Expanded Operations Alternative, the potential impacts to workers and the public of potential accidents involving the release of radioactive and/or chemical materials, explosions, and other hazards. Additional details on the accident analyses and impacts are presented in Appendix F.

Site-Wide Earthquake

An earthquake in the Albuquerque, New Mexico, area has the potential for human injury and building damage throughout the local region. Due to differences in structural design, SNL/NM buildings and structures vary in their capabilities to withstand earthquake forces. Any magnitude earthquake has the potential to cause injury to workers in and around buildings and damage to structures from the physical forces and effects of the earthquake. Additional injury to workers and the public would be possible from explosions and from exposure to chemical and radioactive materials that could be released from buildings and storage containers. Facilities in TA-I are the predominant source of chemical materials that could be released during an earthquake. Facilities in TA-V are the predominant source of radioactive materials that could be released. The ECF in TA-II is the predominant source of explosive materials. Lesser quantities of radioactive materials in TAs-I and -II could also be released and cause exposures to workers and the public.

The UBC specifies different levels of seismic design depending on the location and proposed use of a facility or structure. For office buildings and other nonhazardous use buildings, the UBC specifies an acceleration of 0.17 *g* for the Albuquerque area. This level seismic design would apply to most buildings in TA-I. For those facilities that would contain radioactive materials, the UBC specifies an acceleration of 0.22 *g*. In the event of an earthquake (UBC, 0.17 *g*), various buildings in TA-I could be affected and various chemicals could be released (see Appendix F, Table F.7–7). Larger magnitude earthquakes could cause more serious impacts. The only dominant chemical that changes among the alternatives is arsine, and it is not released in the earthquake at 0.17 *g* and lesser accelerations. Therefore, failure of facilities at lesser accelerations would not affect the differences in risk among the alternatives, and the spectrum of accidents would essentially be unchanged. The shape and direction of the chemical plumes would depend upon local meteorological conditions and physical structures. The plumes shown on Figures 5.4.8–1 and 5.4.8–2 reflect the predominant wind direction during daylight hours. The daylight period was chosen to maximize the number of people potentially affected onsite because more people are working onsite during the day than at night. The shaded area represents the area that could be affected by other wind directions. This area is shown to indicate the potential areas that could be affected. For wind blowing toward the north-northeast, there would be up to 423 people exposed to chemical concentrations above ERPG-2.

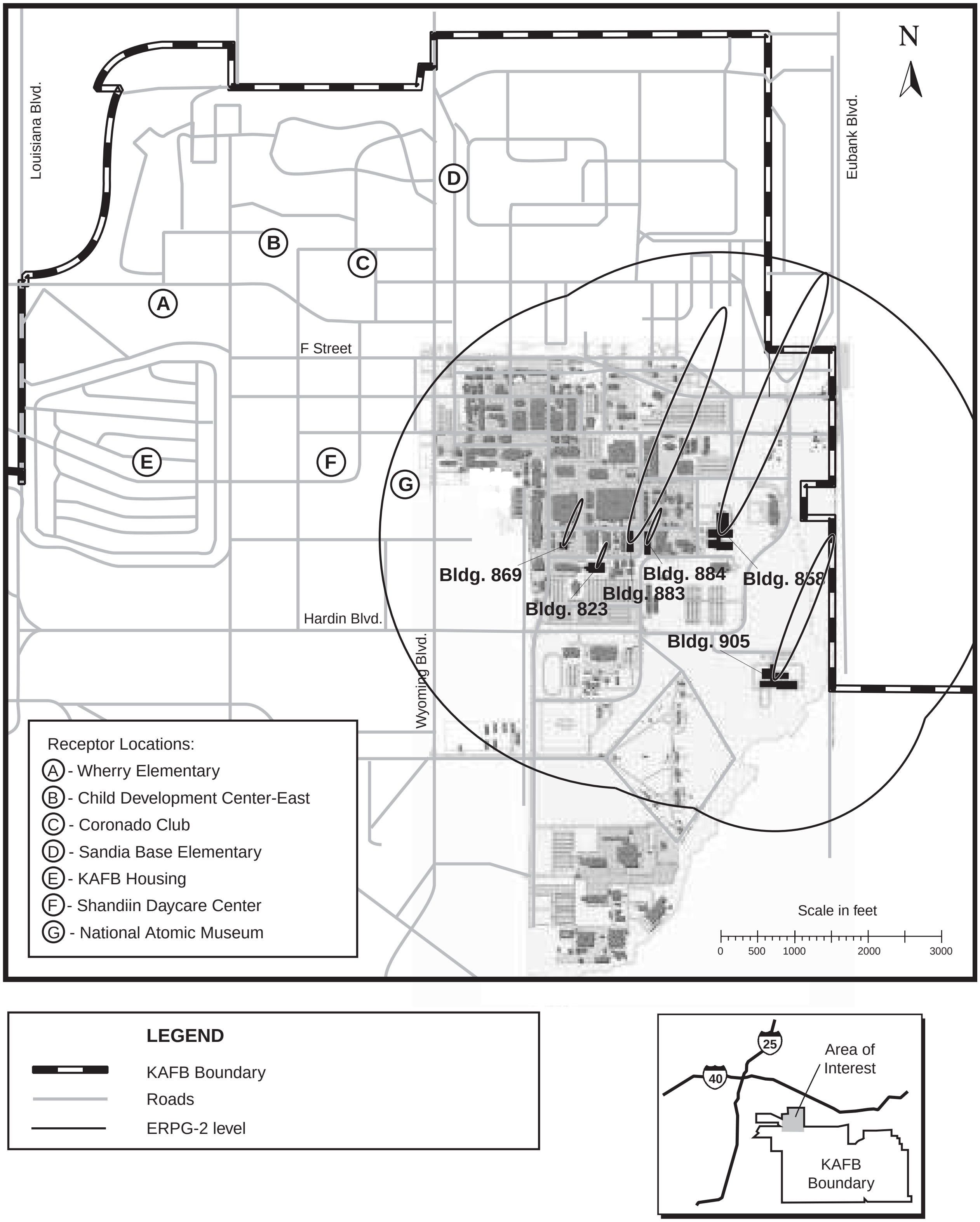
Under the Expanded Operations Alternative, the MDL and the CSRL could be configured in one of two ways. In the current configuration, simultaneous release of chemicals from several buildings, including the MDL and the CSRL, are possible in the event of an earthquake. As many as 423 individuals could be exposed to ERPG-2 in addition to exposures of other persons from chemicals released by other damaged facilities in TA-I (Figure 5.4.8–1). In the second configuration, the CSRL would be shut down and the MDL would be reconfigured as the MESA Complex. The chemical inventory and



Source: Original
Note: see Appendix F.7, Figure F.7–1

Figure 5.4.8–1. Areas Above Emergency Response Planning Guideline 2 from a Site-Wide Earthquake Under the Expanded Operations Alternative without the Microsystems and Engineering Sciences Applications Complex

The circled areas represent locations that could be above ERPG-2, depending on wind direction.



Sources: Original
Note: See *Appendix F.7, Figure F.7-2

Figure 5.4.8–2. Areas Above Emergency Response Planning Guideline Level 2 from a Site-Wide Earthquake Under the Expanded Operations Alternative with the Microsystems and Engineering Sciences Applications Complex

The circled areas represent potential locations where released chemical concentrations could be above ERPG-2, depending on the wind direction.

operations that were part of the CSRL missions would be performed in the new MESA Complex. In the event of an earthquake, the new MESA gas storage facility would remain intact and no chemicals would be released. However, several other facilities could fail, releasing their chemical inventories and resulting in the exposure of as many as 306 individuals to ERPG-2 (Figure 5.4.8–2).

Mitigation features designed to limit the release of chemicals from storage containers, rooms, and buildings would limit or reduce plume size, concentration levels, and exposures. Emergency procedures and sheltering would also minimize exposures to workers and the public.

Nuclear facilities in TAs-I, -II, and -V could also be damaged during an earthquake. The frequency of an earthquake (0.17 *g*) that could cause the release of radioactive materials from TAs-I and -II facilities is 1.0×10^{-3} per year, or 1 chance in 1,000 per year. The frequency of an earthquake (0.22 *g*) that could cause the release of radioactive materials from TAs-I (NG-1), -II (ECF-1), and -V facilities is 7.0×10^{-4} per year, or 1 chance in 1,500 per year. The consequences are shown in Table 5.4.8–4. Descriptions of accident scenarios are given in Section 5.3.8.2 and Appendix F. If a 0.22-*g* earthquake was to occur, there would be an estimated 6.4×10^{-2} additional LCFs in the total population within 50 mi of the site associated with the HC-1 accident scenario. The MEI and noninvolved worker would have an increased probability of LCF of 6.9×10^{-6} and 3.0×10^{-2}, respectively, associated with the HC-1 accident. The risks for these receptors can be estimated by multiplying these consequence values by the probability (frequency) of earthquake. If a stronger earthquake was to occur, larger releases of radioactive materials would be possible and could cause greater impacts.

A severe earthquake could also cause damage to other SNL/NM facilities and result in environmental impacts. For example, the large quantities of oil stored in external tanks and in accelerator buildings in TA-IV could potentially be spilled and cause impacts to the ecosystem and water resources. Underground natural gas lines could break and ignite causing brush and forest fires that could further damage facilities and persons in the vicinity. Hydrogen storage tanks in TA-I could be damaged, causing hydrogen combustion or explosion and potential injury to persons in the vicinity. Explosives in the ECF in TA-II and smaller quantities in other facilities could

Table 5.4.8–4. Site-Wide Earthquake Radiological Impacts Under the Expanded Operations Alternative

ACCIDENT ID[a]	FREQUENCY (per year)	ADDITIONAL LATENT CANCER FATALITIES IN 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
			MAXIMALLY EXPOSED INDIVIDUAL[b]	NONINVOLVED WORKER[c]
TECHNICAL AREA-I				
NG-1	7.0×10^{-4}	5.1×10^{-5}	1.4×10^{-9}	3.2×10^{-6}
TECHNICAL AREA-II				
ECF-1	7.0×10^{-4}	3.0×10^{-6}	1.5×10^{-10}	1.9×10^{-7}
TECHNICAL AREA-V				
AM-2	7.0×10^{-4}	2.0×10^{-3}	2.4×10^{-7}	7.4×10^{-5}
HC-1	7.0×10^{-4}	6.4×10^{-2}	6.9×10^{-6}	3.0×10^{-2}
SP-1	7.0×10^{-4}	9.2×10^{-3}	5.8×10^{-7}	2.7×10^{-4}

Source: Original (See also Appendix F, Tables F.7–4 and F.7–5)
[a] Facility Accident Descriptors:
Neutron Generator Facility: NG-1
Explosive Component Facility: ECF-1
Annular Core Research Reactor-Medical Isotope Production: AM-2
Hot Cell Facility: HC-1
Sandia Pulsed Reactor: SP-1
[b] The maximally exposed individual is located at the Golf Course and the consequences can be added.
[c] Because the uninvolved worker is located 100 meters from the release point, the location varies relative to each technical area. Therefore, the consequences to the noninvolved worker can only be added for a given technical area.
Note: The only earthquake radiological accident that changes among alternatives is AR-5, which contributes only 3.9 person-rem to the 150 person-rem population dose. Therefore, failure of facilities at lesser accelerations than 0.22 *g* would not affect the differences in risk among the alternatives, and the spectrum of accidents would essentially be unchanged.

also be accidentally detonated during an earthquake with an injury to persons in the vicinity. Occupants of all facilities would be at risk of injury as a result of the earthquake forces and building damage.

Facility Hazards

Some of the facilities at SNL/NM contain occupational hazards with the potential to endanger the health and safety of involved workers in the vicinity of an accident. Some of these facilities also contain hazardous materials that, in the event of an accident, could endanger the health and safety of people within the immediate vicinity and beyond. These people include noninvolved SNL/NM workers, members of the military assigned to KAFB, members of the public located within the KAFB boundary and offsite. Offsite consequences were determined to a 50-mi radius around the affected facility.

Radiological, chemical, and explosion accidents with the largest impacts to workers and the public have been analyzed as discussed in the following sections. Potential accidents associated with other facility hazards such as lasers, electricity, X-rays, transformer oil, noise, shrapnel, pyrotechnics, and compressed gases could affect the health and safety of the involved workers. However, the impacts to noninvolved workers and the public for these other accidents would be lower than the impacts from radiological, chemical, and explosion accidents described in the SWEIS (Appendix F, Table F.6–3).

The DOE recognizes the potential adverse effects for workers, the public, and the environment that could result for the deterioration of SNL/NM equipment, structures, and facilities. However, the analysis of potential accidents discussed in this section assumes that the expected deterioration of equipment, structures, and facilities would not affect the occurrence, progression, and effects of accidents. The basis for this assumption is that the DOE safety analysis process, specified in DOE Orders and standards, would require periodic assessments of facility safety to ensure that operations are being performed in an approved safety envelop. The process would also require an assessment of all unresolved safety questions that would result from any change in a facility or operation that could affect the operation's authorization basis. Depending on the results of the assessment, modifications to the facility and/or operational procedures would be implemented to maintain operations in the authorization basis.

Explosion Accidents

Explosive materials are stored, handled, transported, and used at some SNL/NM facilities. Administrative controls and facility design would help prevent an explosion accident and limit the impacts to personnel, if an accident was to occur. The ECF, for example, contains large quantities of explosives for use in its testing programs. Hydrogen trailers are another large source of explosive material. There would be approximately five hydrogen trailers parked near facilities or routinely transported to facilities from remote locations.

In the Final SWEIS the largest quantity of hydrogen with the highest potential for consequences to both SNL/NM workers and facilities would be in a cryogenic tank with a storage capacity of approximately 493,000 SCF (equivalent to 2,203 pounds of trinitrotoluene [TNT]), located northwest of MDL, Building 858, in TA-I. An explosion at the cryogenic tank was selected for detailed analysis to estimate the bounding impacts of an explosion accident. In the Draft SWEIS, a set of horizontally mounted cylinders, with storage capacity of approximately 90,000 SCF, located approximately east of the CSRL, Building 893, in TA-I, represented the bounding explosion accident. An explosion at the hydrogen storage cylinders located near the CSRL was selected for detailed analysis to estimate the bounding impacts of an explosion accident. If a hydrogen explosion were to occur in this relatively populated area of TA-I, individuals in the area could be injured and nearby property could be damaged. Involved workers within 61 ft of an explosion could be seriously injured and would have a 50 percent chance of survival. Involved workers out to a distance of 126 ft from the explosion could receive damage to their eardrums and lungs. The resulting overpressure from this explosion and impacts to personnel and property would diminish with distance.

The actual number of persons in the vicinity of the accident depends upon many factors and the actual number of potential fatalities is uncertain. Factors include the time of day (start of work day, lunchtime, after hours), the actual location of the people (amount of shielding between the hydrogen tank and the person), and the actual spread of the pressure waves in a very complex arrangement of buildings, alleys, and walkways.

In the Draft SWEIS, the bounding facility explosion was postulated to occur from an accidental uncontrolled release of hydrogen stored in a tank outside the CSRL caused by human errors (such as mishandling activities) or equipment failures (such as a pipe joint failure) and the presence of an ignition source (such as a spark) near the location of release. Because multiple failures would have to occur for an uncontrolled release of hydrogen to lead to an

Table 5.4.8–5. Impacts of an Explosion Accident Under the Expanded Operations Alternative

P_r (psi)	PHYSICAL EFFECTS	DISTANCE (ft)	
		472-lb TNT	2203-lb TNT
50	50% survival rate for pressures in excess of 50 psi	61	101
10	50% rate of eardrum rupture and total destruction of buildings for pressures in excess of 10 psi	126	210
2.0	Pressures in excess of 2-3 psi w ill cause concrete or cinder block w alls to shatter.	370	617
1.0	Pressures in excess of 1 psi w ill cause a house to be demolished.	657	1,096

Source: Original, DOE 1992b (See also Appendix F, Table F.4–1)
ft: feet
lbm: pound mass
psi: pounds per square inch
TNT: trinitrotoluene

explosion, this accident scenario would be extremely unlikely (that is, between $1x10^{-6}$ and $1x10^{-4}$ per year).

Based on additional information, the Final SWEIS bounding facility explosion was postulated to occur from an accidental uncontrolled release of hydrogen stored in a tank outside the MDL (see Section 5.3.8.2, Explosion Accidents).

The human organs most vulnerable to shock explosions are the ears and lungs because they contain air or other gases. The damage would be done at the gas-tissue interface, where flaking and tearing could occur. Both the ear and the lung responses would be dependent not only on the overpressure, but also on impulse and body orientation. The shorter the pulse width, the higher the pressure the body could tolerate. An overpressure of approximately 50 psi would result in a 50 percent fatality rate; approximately 10 psi would result in eardrum rupture. These overpressure estimates are based on a square pressure wave with a pulse duration greater than 10 msec, and their effects could vary depending on body orientation to the pressure wave.

Structural damage produced by air blasts would depend on the type of structural material. An overpressure of on the order of 1 psi would cause partial demolition of houses (rendering them uninhabitable). An overpressure of 2 to 3 psi would shatter unreinforced concrete or cinder block walls; and an overpressure of 10 psi would probably cause total destruction of buildings.

Radiological Accidents

The largest quantities of radioactive materials at risk for radiological accidents are located in TA-V. The Manzano Waste Storage Facilities and TAs-I, -II, and -IV also contain radioactive material, but in smaller amounts. The nuclear facilities in TA-V include the ACRR, SPR, HCF and GIF. The NGIF is under construction in TA-V. The planned primary use of the ACRR is medical isotope production (primarily molybdenum-99). The HCF has been reconfigured for medical isotope production and the accidents analyzed reflect this mode of operation. The DP configuration would be conducted in a new Annular Core Pulsed Reactor II (ACPR-II) located in TA-V. It was assumed that the ACPR-II would be a reconstituted version of the ACRR and would behave during accidents exactly as described in the ACRR SAR. Accidents have also been analyzed for storage of radioactive materials in the HCF not associated with molybdenum-99 production. Potential accidents at TA-I, TA-IV, and the Manzano Waste Storage Facilities are discussed in Appendix F.2.

The most serious radiological accident impacts under the Expanded Operations Alternative are shown in Table 5.4.8–6. The table lists a set of accidents and their consequences in terms of an increased probability of an LCF for an exposed individual and an increased number of LCFs for the offsite population. Other radiological accidents could also occur at these facilities, but their consequences would be within the envelope of the selected set of accidents.

The accident with the highest consequences to the public would be a fire in Room 108 at the HCF in TA-V (HS-2). If this accident was to occur, there would be $7.9x10^{-2}$ additional LCFs in the offsite population within 50 mi of the site. There would be increased probabilities of an LCF for the MEI and a noninvolved worker of $6.6x10^{-6}$ and $7.4x10^{-6}$, respectively. The estimated frequency of occurrence for this accident would be

Table 5.4.8–6. Potential Impacts of Radiological Facility Accidents Under the Expanded Operations Alternative

FACILITY	ACCIDENT ID	SCENARIO	FREQUENCY (per year)	ADDITIONAL LATENT CANCER FATALITIES TO 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
					MAXIMALLY EXPOSED INDIVIDUAL	NONINVOLVED WORKER
Annular Core Research Reactor-Medical Isotopes Production Configuration	AM-1	Airplane crash - collapse of bridge crane	6.3×10^{-6}	2.0×10^{-3}	2.4×10^{-7}	7.4×10^{-5}
	AM-3	Rupture of waterlogged fuel element	1.0×10^{-2} to 1.0×10^{-4}	4.9×10^{-4}	5.4×10^{-8}	3.8×10^{-6}
	AM-4	Rupture of one molybdenum-99 target	1.0×10^{-4} to 1.0×10^{-6}	3.9×10^{-4}	4.3×10^{-8}	3.0×10^{-6}
	AM-5	Fuel handling accident - irradiated element	1.0×10^{-4} to 1.0×10^{-6}	4.9×10^{-3}	6.1×10^{-7}	7.6×10^{-5}
	AM-6	Airplane crash and fire in reactor room with unirradiated fuel and targets present	6.3×10^{-6}	1.6×10^{-6}	1.0×10^{-10}	4.9×10^{-8}
	AM-7	Target rupture during Annular Core Research Reactor to Hot Cell Facility transfer	$<1.0 \times 10^{-6}$	3.9×10^{-4}	4.9×10^{-8}	1.4×10^{-5}
Hot Cell Facility-Medical Isotopes Production	HM-1	Operator error - molybdenum-99 target processing	1.0×10^{-1} to 1.0×10^{-2}	3.8×10^{-5}	3.3×10^{-9}	1.6×10^{-7}
	HM-2	Operator error iodine-125 target processing	1.0×10^{-1} to 1.0×10^{-2}	1.6×10^{-6}	1.0×10^{-10}	4.2×10^{-9}
	HM-4	Fire in steel containment box	1.0×10^{-2} to 1.0×10^{-4}	2.6×10^{-3}	2.4×10^{-7}	2.3×10^{-6}
Hot Cell Facility Room 108 Storage	HS-1	Fire in room 108, average inventories	3.3×10^{-5}	2.1×10^{-3}	1.8×10^{-7}	2.0×10^{-7}
	HS-2	Fire in room 108, maximum inventories	2.0×10^{-7}	7.9×10^{-2}	6.6×10^{-6}	7.4×10^{-6}

Table 5.4.8–6. Potential Impacts of Radiological Facility Accidents Under the Expanded Operations Alternative (concluded)

FACILITY	ACCIDENT ID	SCENARIO	FREQUENCY (per year)	ADDITIONAL LATENT CANCER FATALITIES TO 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
					MAXIMALLY EXPOSED INDIVIDUAL	NONINVOLVED WORKER
Sandia Pulsed Reactor	S3M-2	Control element misadjustment before insert	1.0×10^{-4} to 1.0×10^{-6}	1.2×10^{-3}	1.5×10^{-7}	2.5×10^{-4}
	S3M-3	Failure of a fissionable experiment	1.0×10^{-4} to 1.0×10^{-6}	7.9×10^{-3}	8.4×10^{-7}	3.8×10^{-1}
	SS-1	Airplane crash into North Vault storage vault	6.3×10^{-6}	9.2×10^{-3}	5.8×10^{-7}	5.5×10^{-4}
	S4-1	Control-element misadjustment before insert	1.0×10^{-4} to 1.0×10^{-6}	2.2×10^{-3}	2.7×10^{-7}	4.7×10^{-4}
Annular Core Pulsed Reactor-II, Defense Programs	AR-1	Uncontrolled addition of reactivity	$<1.0 \times 10^{-6}$	7.3×10^{-3}	9.3×10^{-7}	1.2×10^{-4}
	AR-2	Rupture of waterlogged fuel element	1.0×10^{-1} to 1.0×10^{-2}	1.3×10^{-3}	1.7×10^{-7}	1.2×10^{-5}
	AR-4	Fire in reactor room with experiment present	1.0×10^{-4} to 1.0×10^{-6}	9.0×10^{-3}	1.0×10^{-6}	1.4×10^{-4}
	AR-6	Airplane crash, collapse of bridge crane	6.3×10^{-6}	5.9×10^{-3}	8.4×10^{-7}	2.2×10^{-4}

Source: Original
ACPR: Annular Core Pulsed Reactor
ACRR: Annular Core Research Reactor
SPR: Sandia Pulsed Reactor
TA: technical area
TA-V Facility Accident Descriptors:
ACRR - Medical Isotope Production: AM-1, AM-3, AM-4, AM-5, AM-6, AM-7
Hot Cell - Medical Isotope Production: HM-1, HM-2, HM-4
Hot Cell - Room 108 Storage: HS-1, HS-2
SPR: S3M-2, S3M3, SS-1, S4-1
ACPR-II-Defense Programs: AR-1, AR-2, AR-4, AR-6

$2.0x10^{-7}$ per year or less than 1 chance in 5,000,000 per year.

Involved workers run the highest risk of injury or fatality in the event of many radiological accidents discussed in this section as well as the many others that could occur. Although there are protective measures and administrative controls to protect involved workers, they are usually in the immediate vicinity of the accidents where they could be exposed to radioactivity.

Accident scenarios for the Expanded Operations Alternative have been described in Section 5.3.8.2.

The impacts to all other receptors would be less than for the MEI. Details on the impacts to all receptors analyzed are provided in Appendix F.2.

Chemical Accidents

Many SNL/NM facilities store and use a variety of hazardous chemicals. For the chemical with the highest RHI in a building, a catastrophic accident and total release of the building inventory was postulated as the bounding event, and estimates were made of the chemical's concentrations at various distances from the accident. The source terms are shown in Table 5.4.8–7. "Building inventory" source term release reflects the variability and uncertainty in the actual amount of the chemical that could be present in inventory at the time of an accident. Similarly, estimates are shown for the range of distances within which the ERPG-2 would be exceeded. The ERPG-2 is an accepted guideline for public exposure (see Appendix F.3 for an explanation of ERPG levels).

In the event of a severe chemical accident in TA-I, involved workers, noninvolved workers, KAFB personnel, onsite residents, and onsite and offsite members of the public would be at risk of being exposed to chemical concentrations in excess of ERPG-2. The number of individuals at risk during normal business hours is shown in Table 5.4.8–8. Although Table 5.4.8–8 shows the number of people at risk, the actual number exposed would depend on the time of day, location of people, wind conditions, and other factors.

Under the Expanded Operations Alternative, the MDL and the CSRL could be configured in one of two ways. In the first, MDL and CSRL would remain in their present configuration. In the event of a catastrophic accident such as an airplane crash into either facility (but not both), the impacts from the dominant chemical release is shown in Figure 5.4.8–3. As many as 409 people could be exposed to chemical concentrations above ERPG-2. In the second configuration, CSRL would be shutdown and MDL would be reconfigured and designated as part of the MESA Complex. The chemical inventory and operations that were part of the CSRL mission would be performed in the new MESA Complex. In this case, the dominant chemical accident release would be 80 pounds of arsine under the conservative assumption that all arsine is stored in one location (Figure 5.4.8–4). As many as 558 people could be exposed to chemical concentrations above ERPG-2. The option exists for the arsine and other similar chemicals to be stored in two separate locations, each containing one half of the amount. The potential and impacts for overlapping plumes are discussed in Section 5.3.8.2 and Appendix F.3.

In the event of an aircraft crash or earthquake involving buildings with various chemical inventories, multiple chemicals would be released. Although the impacts of mixed chemicals could be greater than individual chemicals, their behavior, dispersion, and health effects can be complex and have therefore, not been considered quantitatively. An earthquake could also cause the release of like chemicals from multiple buildings and lead to increased concentration where individual plumes overlap. The potential and impacts for overlapping plumes are discussed in Section 5.3.8.2 and Appendix F.3.

Other Accidents

Other types of potential accidents were identified whose impacts are not measured in terms of LCFs or chemical concentrations. These could cause serious injury or fatality for humans and/or impacts to the nonhuman environment such as the ecology, historical sites, or sensitive cultural sites.

- *Brush Fires*—Small fires are expected and planned for during outdoor testing that involves propellants and explosives. The potential exists for brush and forest fires when hot test debris or projectiles come in contact with combustible elements in the environment. One such incident was reported in 1993 in TA-III when a rocket motor detonated during a sled track impact test and resulted in a 40-ac brush fire. Another accident occurred at the Aerial Cable Facility in the Coyote Test Field, which resulted in a fire that swept up the side of a mountain before being extinguished by SNL/NM workers. Many others have also occurred that were contained in the immediate vicinity of the test area. Measures would be taken to prevent fires and, should a fire occur, the

Table 5.4.8–7. Potential Impacts of Chemical Accidents Under the Expanded Operations Alternative

BUILDING	CHEMICAL	SOURCE TERM	ERPG-2 LEVEL OF CONCERN (ppm)	EXCEEDANCE DISTANCE	FREQUENCY (per year)
		BUILDING INVENTORY (lb)		BUILDING INVENTORY (ft)	
823	Nitrous oxide	30.53	125	351	$1.0x10^{-3}$ to $1.0x10^{-4}$
858	Chlorine	106.4	3	3,726	$1.0x10^{-3}$ to $9.7x10^{-5}$
858	Arsine	40	0.5	5,578	$1.0x10^{-3}$ to $4.9x10^{-5}$
MESA Complex	Arsine[a]	80	0.5	7,920	$1.0x10^{-3}$ to $4.9x10^{-5}$
869	Nitric acid	18.6	15	666	$1.0x10^{-3}$ to $1.0x10^{-4}$
878	Nitrous oxide	50	125	426	$1.0x10^{-3}$ to $3.2x10^{-5}$
880	Hydrofluoric acid	2	20	NR	$1.0x10^{-3}$ to $1.0x10^{-4}$
883	Phosphine	6.8	0.5	3,357	$1.0x10^{-3}$ to $1.0x10^{-4}$
884	Hydrofluoric acid	10	20	504	$1.0x10^{-3}$ to $1.0x10^{-4}$
888	Fluorine	0.07	1	NR	$1.0x10^{-3}$ to $1.0x10^{-4}$
893 [b]	Arsine	65	1	6,891	$1.0x10^{-3}$ to $1.0x10^{-4}$
897	Chlorine	4.4	3	699	$1.0x10^{-3}$ to $6.6x10^{-5}$
905	Thionyl chloride	101.1	5	2,067	$1.0x10^{-3}$ to $9.0x10^{-5}$

Sources: NSC 1995, SNL/NM 1998a, SNL/NM 1998b (See also Appendix F, Tables F.3–3 and F.3–4)
ERPG: Emergency Response Planning Guideline
ft: feet
lb: pound
MESA: Microsystems and Engineering Sciences Applications
NR: Not Reported due to model limitations
ppm: parts per million
823 Systems and Development
858 Microelectronics Development Laboratory
869 Industrial Hygiene Instrumentation Laboratory
878 Advanced Manufacturing Processes Laboratory
880 Computing Building
883 Photovoltaic Device Fabrication Laboratory
884 6-MeV Van der Graaf Tandem Generator
888 Lightning Simulation Facility
893 Compound Semiconductor Research Laboratory
897 Integrated Materials Research Laboratory
905 Explosive Components Facility

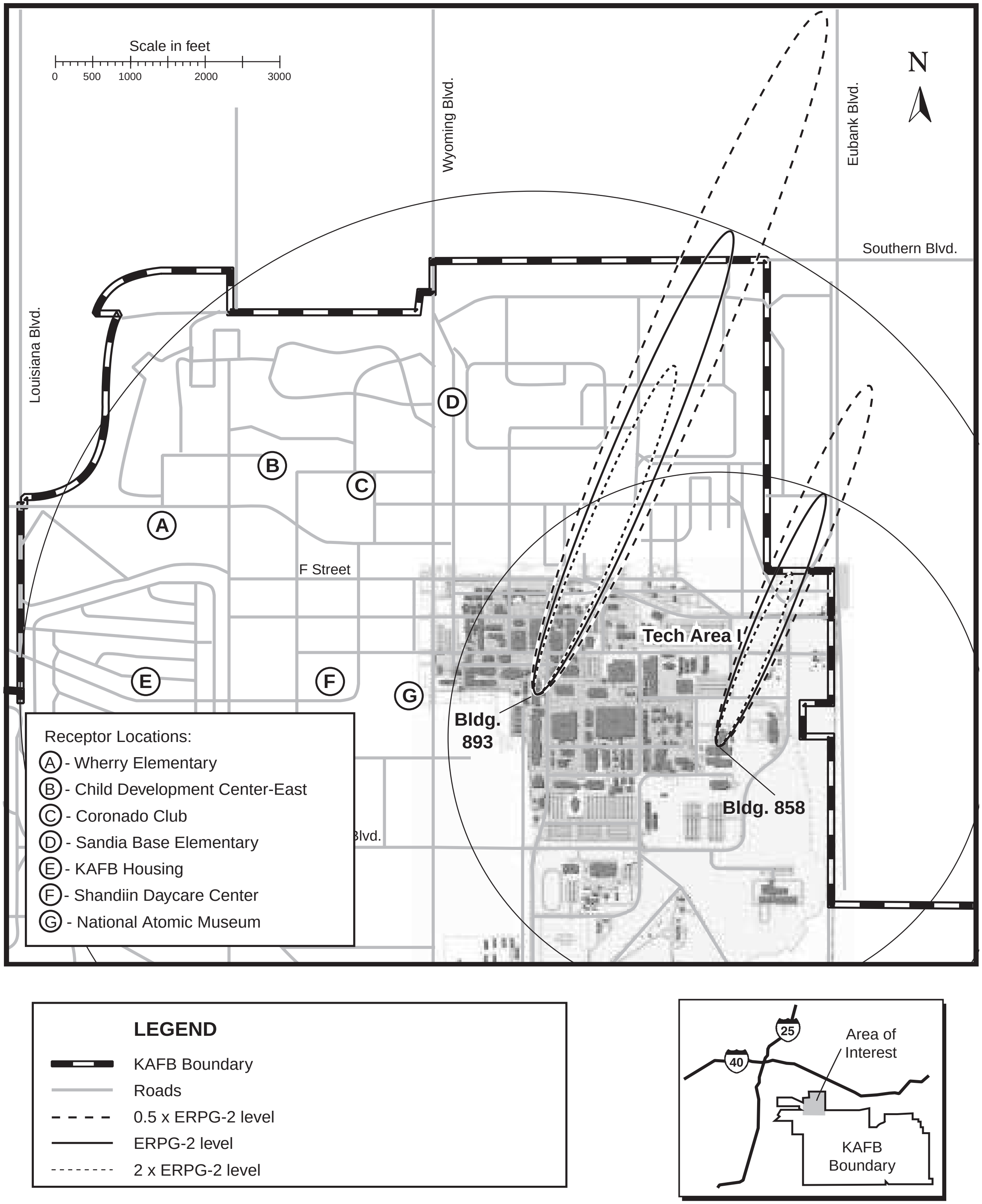
[a] If the MESA Complex is not constructed, this facility would not contribute to the potential impacts of chemical accidents under the Expanded Operations Alternative.

[b] If the MESA Complex is constructed, this facility would not contribute to the potential impacts of chemical accidents under the Expanded Operations Alternative.

Table 5.4.8–8. Maximum Impacts of Chemical Accidents on Individuals Within the KAFB Under the Expanded Operations Alternative

BUILDING	CHEMICAL NAME	RELEASE (lb)	ALOHA DISTANCE REQUIRED TO REACH ERPG-2 LEVEL (ft)	NUMBER OF PEOPLE WITHIN ERPG-2
823	Nitrous oxide	32.17	348	2
858	Chlorine	106.41	3,726	141
MESA Complex	Arsine[a]	80	7,920	558
869	Nitric acid	18.6	666	6
878	Nitrous Oxide	50	438	3
880	Hydrofluoric acid	2	NR	
883	Phosphine	6.8	3,357	100
884	Hydrofluoric acid	10	504	2
888	Fluorine	0.07	NR	NR
893	Arsine[b]	65	4,884	409
897	Chlorine	4.4	699	5
905	Thionyl chloride	101.1	2,067	55

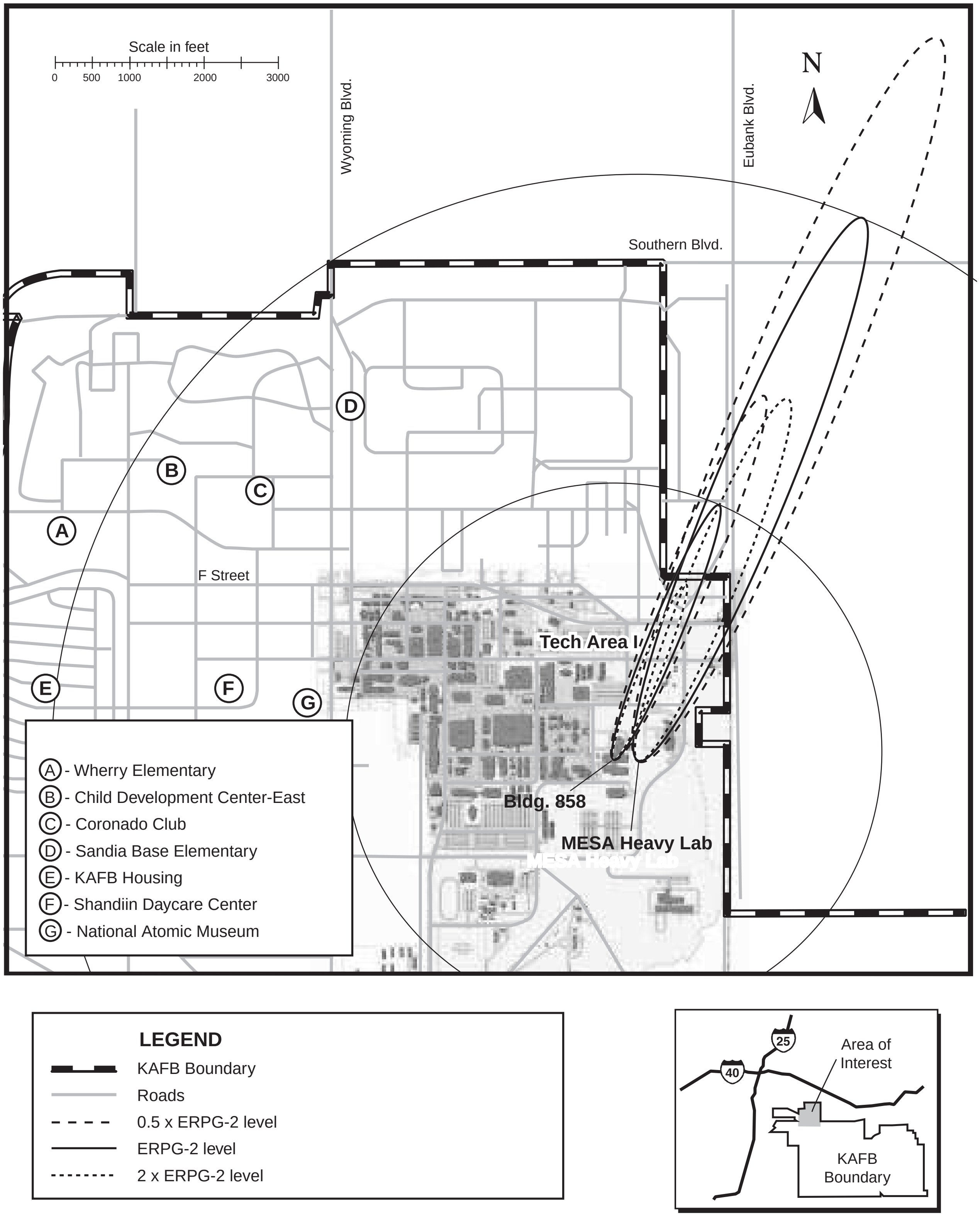
Source: See Appendix F, Table F.3–6
ALOHA: Areal Locations of Hazardous Atmospheres (model)
ERPG: Emergency Response Planning Guideline
ft: feet
lb: pound
MESA: Microsystems and Engineering Sciences Applications
NR: Not reported, the model did not provide a plume footprint due to near-field unreliability. No population estimates are available.
823 Systems and Development
858 Microelectronics Development Laboratory
869 Industrial Hygiene Instrumentation Laboratory
878 Advanced Manufacturing Processes Laboratory
880 Computing Building
883 Photovoltaic Device Fabrication Laboratory
884 6-MeV Van der Graaf Tandem Generator
888 Lightning Simulation Facility
893 Compound Semiconductor Research Laboratory
897 Integrated Materials Research Laboratory
905 Explosive Components Facility
[a] If the MESA Complex is not constructed, it would not contribute to the potential impacts of chemical accidents under the Expanded Operations Alternative.
[b] If the MESA Complex is constructed, this facility would not contribute to the potential impacts of chemical accidents under the Expanded Operations Alternative.



Sources: Original
Note: See Table 5.4.8–8

Figure 5.4.8–3. Areas Above Emergency Response Planning Guideline 2 from Accidental Release of Arsine (Building 893) and Chlorine (Building 858)

The encircled areas represent potential locations that could be above ERPG-2, depending upon the wind direction for an accidental release of arsine (Building 893) or chlorine (Building 858) under the Expanded Operations Alternative without the MESA Complex.



Sources: Original
Note: See Table 5.4.8–8

Figure 5.4.8–4. Areas Above Emergency Response Planning Guideline 2 from Accidental Release of Arsine (Microsystems and Engineering Sciences Application Complex) and Chlorine (Building 858)

The encircled areas represent potential locations that could be above ERPG-2, depending upon the wind direction for an accidental release of arsine (MESA Complex) or chlorine (Building 858) under the Expanded Operations Alternative, the MESA Complex configuration.

effects would be reduced by activating fire fighting facilities in the test area (DOE 1995a, SNL/NM 1993d, SNL/NM 1998i).

- *Natural Phenomena*—Naturally occurring events such as tornadoes, lightning, floods, and heavy snow, as documented in existing SNL/NM safety documentation, have been considered for their potential to initiate the accidental release of radioactive, chemical, and other hazardous materials that affect workers and the public. Any of these events, should they occur, could also lead to serious injury or fatality as a result of the physical and destructive forces associated with the events. The risks of such events to workers and the public would be equivalent to everyday risks from naturally occurring events to the general public wherever they work and reside.
- *Spills and Leaks*—The potential would exist throughout SNL/NM for the accidental spill of radioactive, chemical, or other hazardous materials. The effects of such spills on workers and the public through airborne pathways were considered earlier in this section. The impacts from pathways other than airborne would normally be bounded by exposure from airborne pathways. Any spill of a hazardous substance would have the potential for impacts to the nonhuman elements of the environment. A spill could make its way into surface and groundwater systems, affecting water quality and aquatic life. Spills of flammable substances could cause fires that damage plant and animal life and other land resources. There have been spills of hazardous substances at the SNL/NM site that had the potential to affect the nonhuman elements of the environment. In 1994, over 100 gal of oil were spilled at the Centrifuge Complex in TA-III when a hydraulic pump failed during a centrifuge test, causing a potential impact to the nonhuman elements of the environment. Also in 1994, a small spill of transformer oil occurred from an oil storage tank in TA-IV when a gasket failed and, at the Coyote Test Field, a leaking underground storage tank containing ethylene glycol was discovered.
- *Radiological and Chemical Contamination*—Some accidents analyzed in this section and others, that were considered but not analyzed, could potentially impact the nonhuman elements of the environment. Any accidentally released chemicals would result in concentrations that would typically decrease with increasing distance from the point of release. While chemical concentrations would diminish over distance to a point where a human hazard would no longer be present, the concentrations could still affect other elements of the environment such as the ecology, water quality, and cultural resources. Radiological releases could also affect nonhuman elements of the environment. After an accident, SNL/NM, through their spill and pollution control and radiological emergency response plans, would be required to assess the potential for ground contamination; if contamination exceeds guidance levels, plans would be developed for remediation.
- *Industrial*—Besides radioactive and chemical materials and explosives, many SNL/NM facilities conduct operations and use materials and equipment that could be potentially hazardous to workers. These hazards are typically referred to as normal industrial hazards, not unlike similar hazards that workers are exposed to throughout the nation, and include working with electricity, climbing ladders, welding, and driving forklifts. All operations and activities at SNL/NM facilities, as well as all DOE facilities, would be subject to administrative procedures and safety features designed to prevent accidents and mitigate their consequences should they occur.

5.4.9 Transportation

The implementation of the Expanded Operations Alternative would result in transportation impacts for each of three ROIs: KAFB; major Albuquerque roadways; and major roadways between Albuquerque and specific waste disposal facilities, vendors, and other DOE facilities. This analysis involved estimating the number of trips made by SNL/NM-associated vehicles under normal operations in each of these transportation corridors. Transportation evaluation and multipliers are discussed in Section 5.3.9, Appendix A, and Appendix G.

If implemented, the MESA Complex configuration would not increase the number of material shipments, material receipts, and waste shipments projected under the Expanded Operations Alternative. The amount of material shipped per trip could vary to accommodate the material and waste shipment requirements resulting from the addition of MESA. Overall traffic volume would not increase beyond the current projected Expanded Operations Alternative increase of 10 percent. MESA would not increase employment levels. The construction of the MESA Complex, however, could result in a temporary increase in onsite and area material transportation during a 36-month period.

5.4.9.1 Transportation of Material and Wastes

In general, the number of material shipments received by SNL/NM would be proportional to total SNL/NM material consumption. According to facility projections, material consumption under the Expanded Operations Alternative would increase by 484 percent over baseline levels. Thus, total material shipments would also increase, although not necessarily for all types of material.

Radioactive and explosive material shipments are often delivered by government carriers, unless the quantities and activities being transported are low enough to meet the Federal guidelines and restrictions in place for authorized commercial transporters. Government carriers operate on an as-needed basis, thus the general increase in material inventory under the Expanded Operations Alternative would result in a similar increase in these kinds of shipments.

Due to their shipment method, there would be very little impact to the number of chemical shipments that are made to SNL/NM. JIT chemicals, which are ordered infrequently and in small quantities, are usually shipped to SNL/NM by way of commercial carriers such as Federal Express and UPS. These carriers make daily shipments to SNL/NM to deliver packages other than chemicals, and an increase in the volume of chemicals they handle per shipment would not increase their frequency. Similarly, major chemical vendors who deliver their own material, rather than use a commercial carrier, also generally make daily shipments to SNL/NM. Therefore, any increase in the volume of material that major vendors ship per load would not have an impact on the frequency of those shipments. Thus, chemical shipments would remain at approximately the same level regardless of the fluctuations in material consumption.

Considering the above factors, overall material transportation due to normal operations would increase by 123 percent over baseline levels. The anticipated changes in annual and daily material shipments for each material category are presented in Table 5.4.9–1. The analysis assumed that SNL/NM has 250 work days per calendar year.

Waste Transportation

The amount of waste shipped from SNL/NM to disposal facilities would correlate directly to SNL/NM waste generation levels. The overall offsite waste shipments would increase by 320 percent under the Expanded Operations Alternative. Of this increase, 285 percent is considered to be waste currently disposed of at the KAFB landfill. This leaves a real projected increase of 35 percent under the Expanded Operations Alternative. The total anticipated changes in waste shipments during all operations for each type of waste are presented in Table 5.4.9–2 and Appendix G, Table G.3–3.

Specials Projects

Two special project wastes, ER Project and legacy, were addressed separately due to their one-time operation/project status and in order to avoid skewing the SNL/NM normal operations impact. Legacy wastes would be anticipated to account for an additional 18 shipments of LLW, 3 shipments of LLMW, and 2 shipments of TRU/MTRU wastes over the 10-year time frame (see Figures 4.12–1, 4.12–2, and 4.12–3). In 1998 through 2000, the ER Project could account for up to an additional 312 offsite shipments of LLW, 101 offsite shipments of LLMW, 2 offsite shipments of RCRA waste, 5 offsite shipments of TSCA waste, and 75 shipments of nonhazardous waste. Both of these special projects have been included within the total facility risks.

Offsite Receipts and Shipments of Material and Waste

The bounding case for this analysis assumed that each material and waste shipment is composed of two trips: one to and one from SNL/NM. Thus, the total number of trips made by material and waste transporters under the Expanded Operations Alternative would be 17,182 (total shipments x 2). Assuming that the year is comprised of 250 work days, the average work day traffic within KAFB contributed by these carriers would be 69 trips. This would be small in comparison to the 29,880 trips of SNL/NM vehicles entering and exiting KAFB under this alternative (SNL/NM 1998a, SNL 1996c). Therefore, the overall traffic impacts on KAFB from increased SNL/NM material and waste shipments under the Expanded Operations Alternative would be negligible.

Shipments of Material and Waste in the Albuquerque Area

The total SNL/NM placarded material and waste shipment traffic would comprise 1.9 percent, or 69 trips per day, of the total placarded truck traffic (1,767) entering the greater Albuquerque area during the applicable base year (1996 or 1997). Although a 137-percent increase in SNL/NM placarded material and waste truck traffic would be expected, this increase would represent the inclusion of waste currently managed at the KAFB landfill and new shipments from the MIPP. ER Project wastes and legacy wastes are addressed

Table 5.4.9–1. SNL/NM Annual Material Shipments Under the Expanded Operations Alternative

MATERIAL TYPE		ANNUAL SHIPMENTS	
		BASE YEAR[a]	EXPANDED OPERATIONS
Radioactive		305	1,782
Radioactive (medical isotopes production configuration)	***Receiving***	0	55
	Shipping	0	1,140
Chemical		2,750	2,750
Explosive		303	1,771
TOTAL		**3,358**	**7,498**

Sources: SNL/NM 1997b, 1998a
MESA: Microsystems and Engineering Sciences Applications
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

Note: No shipment increases would be due to MESA, because the amount of material shipped could vary to accommodate the material shipment requirements resulting from the construction and operation of MESA.

Table 5.4.9–2. Annual Waste Shipments from Normal Operations Under the Expanded Operations Alternative

WASTE TYPE	BASE YEAR SHIPMENTS	EXPANDED OPERATIONS SHIPMENTS
LLW [a] (1996)	4	21
LLMW (1996)	1	3
Hazardous (RCRA+TSCA) [a] (1997)	102	150
Recyclable (Hazardous and Nonhazardous) [a,b] (1997)	86	233
Solid[a] (Municipal, Construction, and Demolition)[b] (1996)	51	650

Sources: Rinchem 1998a; SNL/NM 1998a, 1998y, n.d. (d)
LLMW: low-level mixed waste
LLW: low-level waste
MESA: Microsystems and Engineering Sciences Applications
MTRU: mixed transuranic
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] Excludes decontamination and decommissioning
[b] Recyclable and solid wastes currently handled by the KAFB landfill could be shipped offsite, contributing an additional 741 shipments.
Note: No shipment increases would be due to MESA, because the amount of material shipped could vary to accommodate the material shipment requirements resulting from the construction and operation of MESA.

separately under special projects. Thus, the impacts under the Expanded Operations Alternative would be minimal.

Shipments of Material and Waste Outside of Albuquerque

All material and waste transported to and from SNL/NM from outside Albuquerque must enter and depart the city by way of Interstate-25 or Interstate-40. Table 5.4.9–3 presents the impacts to those corridors from material and waste shipments under the Expanded Operations Alternative. Specific remote facility locations are listed in Section 4.11. Daily SNL/NM shipment figures were derived for comparison purposes by dividing the annual waste and material shipment totals in Tables 5.4.9–1 and 5.4.9–2 by the approximately 250 work days in a calendar year.

Based on this analysis, SNL/NM material and waste shipments would be expected to increase in frequency by 137 percent under this alternative. However, the SNL/NM truck traffic would only comprise 0.021 percent, or 34.4 shipments per day, of all traffic (165,000 vehicles per day), including all types of vehicles, projected to be entering and departing Albuquerque by way of interstates. For the applicable base year (1996 or 1997), waste leaving Albuquerque represented 35 percent of the total shipments, with an additional 20 percent going to Rio Rancho. Because most materials are supplied through the JIT vendors,

Table 5.4.9–3. 24-Hour Placarded Material and Waste Truck Traffic Counts Under the Expanded Operations Alternative

ROUTE (ALL TRAFFIC)[a]	BASE YEAR[b]	EXPANDED OPERATIONS
I-25 North (52,400)	230	268
I-25 South (18,000)	94	110
I-40 West (16,400)	621	725
I-40 East (54,200)	569	664
TOTAL (141,000)	**1,514**	**1,767**
SNL/NM[c]	**14.5**	**34.4**

Sources: SNL/NM 1997b, 1998a; Scientific Services 1995
I: Interstate
[a] Total vehicle count for all types of vehicles entering and departing Albuquerque
[b] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[c] SNL/NM placarded trucks

origination points are generally not known. However, most vendors use local suppliers; therefore, in the base year, 82 percent of material was assumed to be provided locally, with the remaining 18 percent coming from outside Albuquerque. Thus, the impact to this ROI from the Expanded Operations Alternative would be negligible.

5.4.9.2 Other Transportation (Traffic)

Overall vehicular traffic impacts under the Expanded Operations Alternative were assessed by projecting the total increased number of SNL/NM commuter vehicles traveling to and from SNL/NM. The term commuter includes all vehicles operated by SNL/NM employees, contractors, and visitors; DOE employees; and additional traffic, such as delivery vehicles.

Traffic on KAFB

Table 5.4.9–4 presents general anticipated traffic impacts at KAFB under the Expanded Operations Alternative. The number of SNL/NM commuter vehicles traveling to and from the site each work day was conservatively assumed to increase at the same rate as the SNL/NM work force level (see Section 5.4.12). Based on this analysis, overall KAFB traffic would increase by 3.6 percent under this alternative.

Table 5.4.9–5 shows projected 24-hour KAFB vehicular flow for each of the three main gates under the Expanded Operations Alternative. It was assumed that the Carlisle and Truman gates would be used primarily by KAFB personnel and not by SNL/NM employees. For the bounding case for this analysis, it was assumed that the SNL/NM contribution to total KAFB flow at each gate would fluctuate by the same factor as the total fluctuation in SNL/NM traffic under the Expanded Operations Alternative.

Based on this analysis, the daily KAFB gate traffic would increase by 3.6 percent under the Expanded Operations Alternative (Table 5.4.9–5). This minimal change would not have an appreciable impact on service at the gates.

Short-term adverse traffic impacts would potentially occur onsite during routine construction activities at KAFB due to traffic lane restrictions, reduced speeds in construction areas, and traffic increases in slower moving heavy equipment. These common occurrences would be similar to those under the No Action Alternative. If implemented, the construction of the MESA Complex would result in a temporary increase in onsite and area traffic during a 36-month period. Building construction and onsite roadway rehabilitation are currently planned under the Expanded Operations Alternative. Short-term circulation impacts would potentially occur if vehicles are rerouted to avoid construction areas. However, it is anticipated that adequate detour routes and signage would be provided and that the impacts would be minimal and limited in duration.

Traffic in the Albuquerque Area

To determine the traffic impacts in the Albuquerque traffic corridor, roadways most likely to be affected by SNL/NM traffic were selected for analysis. The bounding case used the projected SNL/NM traffic contributions from Table 5.4.9–5 to approximate the SNL/NM component of the total traffic count for each roadway. For worst-case impacts, the SNL/NM traffic component was assumed to be equivalent to the total SNL/NM traffic at the nearest gate. In actuality, a significant percentage of traffic would likely diffuse onto other nearby roads, which would greatly reduce the magnitude of the SNL/NM component. The projected impacts to these roadways under the Expanded Operations Alternative, according to the bounding case factors, are presented in Table 5.4.9–6.

This represents an overall average increase of 10 percent of the SNL/NM traffic component on these roadways. However, the total traffic on these roadways would only increase by 2.9 percent overall under the Expanded Operations Alternative.

Table 5.4.9–4. KAFB Daily Traffic Projections Under the Expanded Operations Alternative

COMPONENT	BASE YEAR[a]			EXPANDED OPERATIONS			% CHANGE IN BASE YEAR VERSUS EXPANDED
	%	VEHICLES	TRIPS	%	VEHICLES	TRIPS	
SNL/NM Commuters	36	13,582	27,164	38	14,940	29,880	10
KAFB Commuters	64	24,145	48,290	63	24,145	48,290	0
TOTAL KAFB COMMUTER TRAFFIC	**100**	**37,727**	**75,453**	**100**	**39,085**	**78,170**	**3.6**
SNL/NM Waste & Material Transporters	0.04	14.5	29	0.09	34.4	69	137[b]

Sources: SNL/NM 1997a, 1997b

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

[b] SNL/NM commuter and transporter trips per day equals 36 percent of total KAFB trips per day.

Table 5.4.9–5. Total KAFB Gate Traffic Under the Expanded Operations Alternative

GATE	BASE YEAR[a]			EXPANDED OPERATIONS ALTERNATIVE			% CHANGE
	24-HOUR SNL/NM[b]	24-HOUR TOTAL[c]	PEAK HOUR[d]	24-HOUR SNL/NM	24-HOUR TOTAL	PEAK HOUR	GATE TOTAL
Wyoming	7,141	19,835	1,941	7,855	20,549	2,011	3.6
Eubank	5,324	14,788	2,683	5,856	15,320	2,951	3.6
Gibson	8,108	22,523	1,571	8,919	23,334	1,628	3.6
AVERAGE	**6,858**	**19,048**	**2,065**	**7,543**	**19,734**	**2,197**	**3.6**

Sources: SNL/NM 1997a, 1997b; USAF 1995e

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

[b] This increase represents inclusion of waste managed at the KAFB landfill and new shipments from medical isotopes production.

[c] Total KAFB trips per day.

[d] Total KAFB trips per hour, traffic counts

Table 5.4.9–6. Albuquerque Daily Traffic Counts Under the Expanded Operations Alternative

ROADWAY		BASE YEAR[a]		EXPANDED OPERATIONS		% CHANGE
		DAILY[b]	PEAK[c]	DAILY	PEAK	DAILY
Gibson West at Louisiana	***Total***	15,671	2,066	16,482	2,172	+5
	SNL/NM	8,108	1,069	8,919	1,176	+10
	% SNL/NM	52		54		+4
Wyoming South of Lomas	***Total***	37,639	2,293	38,353	2,337	+2
	SNL/NM	7,141	435	7,855	479	+10
	% SNL/NM	19		20		+5
Eubank South of Copper	***Total***	14,572	1,852	15,104	1,920	+4
	SNL/NM	5,324	677	5,856	744	+10
	% SNL/NM	37		39		+5
Interstate-25 at Gibson[d]	***Total***	91,000	-	91,811	-	+1
	SNL/NM	8,108	-	8,919	-	+10
	% SNL/NM	8.9		9.7		+9
Interstate-40 at Eubank[d]	***Total***	90,300	-	90,832	-	+0.6
	SNL/NM	5,324	-	5,856	-	+10
	% SNL/NM	5.9		6.5		+10
Wyoming North of KAFB Gate	***Total***	20,272	1,749	20,986	1,811	+4
	SNL/NM	7,141	612	7,855	673	+10
	% SNL/NM	35		37		+6

Sources: MRGCOG 1997b, 1997c; SNL/NM 1997b, 1998a; UNM 1997b

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

[b] Vehicles per day, *1996 Traffic Flows for the Greater Albuquerque Area*

[c] Vehicles per hour, *1996 – 1998 Traffic Counts*

[d] Peak hour counts for this intersection are not available.

Traffic Outside of Albuquerque

The additional local SNL/NM traffic under the Expanded Operations Alternative would have minimal impacts on transportation routes between Albuquerque and other DOE facilities, vendors, and disposal facilities (see Section 4.11 for a list of these facilities). In a worst-case assessment, the applicable base year (1996 or 1997) SNL/NM component represents an average 19 percent of the total traffic count (141,000 vehicles per day) on major roadways entering and departing Albuquerque (MRGCOG 1997b). Under the Expanded Operations Alternative, the SNL/NM component would decrease to 18.1 percent of total vehicular traffic due to the increase in Albuquerque population and commuters. This assumes that all SNL/NM traffic would actually enter and depart Albuquerque by way of the interstates every day, although a significant portion of SNL/NM traffic would more likely diffuse onto other roadways and remain in Albuquerque.

5.4.9.3 Transportation Risk Associated with Normal Operations

Incident-Free Exposure

The representative conservative case for this analysis used the distances traveled by SNL/NM waste and material carriers, as listed in Table 5.3.9–7. These distances were based on the average distance traveled by trucks in route to other facilities under all alternatives.

Truck emissions impacts are a function of the number of truck shipments to and from SNL/NM. The bounding case for truck emissions impact analysis assumed that the greatest risk is when these shipments are transported through urban areas, such as the Albuquerque transportation corridor, because these areas are most susceptible to emissions related problems. To evaluate the actual risk associated with SNL/NM truck shipments, the most common origin and destination of all shipments of concern were compiled to determine the urban distance each material or waste would be transported (Section 4.11). Table 5.4.9–7 presents projected truck emissions impacts resulting from the Expanded Operations Alternative.

Based on this analysis, the emissions impacts due to increased truck traffic under the Expanded Operations Alternative would increase from 1.33×10^{-2} to 6.4×10^{-2} annual LCFs.

The radiological impact exposure to incident-free routine transportation of radioactive materials was analyzed using *RADTRAN 4* (SNL 1992a), as described in Appendix G. Routes and population densities were modeled using *HIGHWAY* (Johnson et al. 1993). Results of these calculations are presented in Table 5.4.9–8.

In the absence of an accident that compromises package integrity, no incident-free chemical or explosive exposure would be foreseen to affect the public, workers, or vehicle transport crews under this alternative.

5.4.9.4 Transportation Risks Associated with Accidents

General Accidents

The bounding case for general vehicular traffic impacts under the Expanded Operations Alternative assumes that the percent increase in accidents would be equal to the percent increase in SNL/NM traffic. Therefore, SNL/NM traffic accidents would increase by 10 percent under this alternative.

Hazardous Material/ Waste-Related Accidents

In conjunction with traffic fatality statistics (SNL 1986), the SNL/NM material and waste shipments projected in Tables 5.4.9–1 and 5.4.9–2 were used to project the truck accident fatality incidence rate that would be expected under the Expanded Operations Alternative. These impacts for the bounding case are presented in Table 5.4.9–9 with details in Appendix G. Based on this analysis, accident fatalities due to SNL/NM truck transportation would increase from 0.22 to 1.9 (1.2 plus 7.1×10^{-2}) under this alternative.

5.4.9.5 Radiological Transportation Accidents

The annual risk to population due to transportation accidents that potentially involve radiological releases resulting from the Expanded Operations Alternative are presented in Table 5.4.9–10.

This analysis indicates that under normal routine operations, LCFs would increase from 1.2×10^{-3} to 6.8×10^{-3} in incidents of LCFs due to the worst-case radiological transportation accident under the Expanded Operations Alternative. In addition, 5.5×10^{-5} LCFs would result from legacy and ER Project waste shipments. For more information, see Appendix G.

Risks due to radiological, chemical, and explosives accidents are evaluated in detail in Appendix F. The bounding transportation accident analysis involves explosion of a

Table 5.4.9–7. Expanded Operations Alternative Incident-Free Exposure: Truck Emissions

CARGO	UNIT RISK[a] FACTOR PER URBAN KILOMETER	URBAN DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER ROUND TRIP SHIPMENT	ANNUAL NO. SHIPMENTS		ANNUAL LCFs	
				BASE YEAR[b]	EXPANDED OPERATIONS	BASE YEAR[b]	EXPANDED OPERATIONS
NORMAL ROUTINE OPERATIONS							
RAD Materials	$1.0x10^{-7}$	73	$1.5x10^{-5}$	305	1,782	$4.6x10^{-3}$	$2.8x10^{-2}$
Explosives	$1.0x10^{-7}$	48	$9.6x10^{-6}$	303	1,771	$2.9x10^{-3}$	$1.7x10^{-2}$
Chemicals	$1.0x10^{-7}$	8	$1.6x10^{-6}$	2,750	2,750	$4.4x10^{-3}$	$4.4x10^{-3}$
LLW	$1.0x10^{-7}$	33	$6.6x10^{-6}$	4	21	$2.6x10^{-5}$	$1.4x10^{-4}$
Medical Isotopes Production (Receipts)	NA	NA	NA	0	55	0	$1.0x10^{-2}$
Medical Isotopes Production (Shipments)				0	1,140		
LLMW (Shipments)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	1	3	$8.1x10^{-6}$	$2.4x10^{-5}$
LLMW (Receipts)	$1.0x10^{-7}$	35.6	$7.1x10^{-6}$	0	1	0	$7.1x10^{-6}$
Hazardous Waste	$1.0x10^{-7}$	33	$6.6x10^{-6}$	64	112	$4.2x10^{-4}$	$7.4x10^{-4}$
Recyclable Hazardous to CA	$1.0x10^{-7}$	23	$4.6x10^{-6}$	2	4	$9.2x10^{-6}$	$1.8x10^{-5}$
Recyclable Hazardous to NM	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	6	11	$7.8x10^{-6}$	$1.4x10^{-5}$
Solid Waste	$1.0x10^{-7}$	10	$2.0x10^{-6}$	51	51	$1.0x10^{-4}$	$1.0x10^{-4}$
D&D Hazardous Waste TSCA-PCBs	$1.0x10^{-7}$	33	$6.6x10^{-6}$	1	1	$6.6x10^{-6}$	$6.6x10^{-6}$
D&D Hazardous Waste TSCA-Asbestos	$1.0x10^{-7}$	10	$2.0x10^{-6}$	14	14	$2.8x10^{-5}$	$2.8x10^{-5}$
Biohazardous Waste	$1.0x10^{-7}$	24	$4.8x10^{-6}$	1	1	$4.8x10^{-6}$	$4.8x10^{-6}$
Recyclable D&D Hazardous Waste	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	22	22	$2.9x10^{-5}$	$2.9x10^{-5}$
Recyclable Nonhazardous Solid Waste	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	78	78	$1.0x10^{-4}$	$1.0x10^{-4}$
Nonhazardous Landscaping Waste	$1.0x10^{-7}$	10	$2.0x10^{-6}$	NA	142	NA	$2.8x10^{-4}$
Construction and Demolition Solid Waste	$1.0x10^{-7}$	10	$2.0x10^{-6}$	NA	599	NA	$1.2x10^{-3}$
RCRA Hazardous Waste (Receipt)	$1.0x10^{-7}$	3	$6.0x10^{-7}$	12	25	$7.2x10^{-6}$	$1.5x10^{-5}$
LLW (D&D)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	4	4	$2.6x10^{-5}$	$2.6x10^{-5}$
TOTAL[bc]						**$1.33x10^{-2}$**	**$6.2x10^{-2}$**

Table 5.4.9–7. Expanded Operations Alternative Incident-Free Exposure: Truck Emissions (concluded)

CARGO	UNIT RISK[a] FACTOR PER URBAN KILOMETER	URBAN DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER ROUND TRIP SHIPMENT	ANNUAL NO. SHIPMENTS		ANNUAL LCFs	
				BASE YEAR[b]	EXPANDED OPERATIONS	BASE YEAR[b]	EXPANDED OPERATIONS
SPECIAL PROJECT OPERATIONS/TOTAL SHIPMENTS							
TRU/MTRU	$1.0x10^{-7}$	8.4	$1.7x10^{-6}$	0	4	0	$6.8x10^{-6}$
TRU/MTRU (Legacy)	$1.0x10^{-7}$	8.4	$1.7x10^{-6}$	0	2	0	$3.4x10^{-6}$
LLW (Legacy)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	56	0	$3.7x10^{-4}$
LLMW (Legacy)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	0	8	0	$6.5x10^{-5}$
LLW (ER)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	136	0	$9.0x10^{-4}$
LLMW (ER)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	0	5	0	$4.1x10^{-5}$
Hazardous Waste (ER)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	113	0	$7.5x10^{-4}$
Nonhazardous Solid Waste(ER)	$1.0x10^{-7}$	10	$2.0x10^{-6}$	0	9	0	$1.8x10^{-5}$
TOTAL[bc]						**0**	**$2.1x10^{-3}$**

Sources: DOE 1996h; SNL 1992a; SNL/NM 1997b, 1982, 1998a
D&D: decontamination and decommissioning
ER: environmental restoration
km: kilometers
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
NA: not applicable
PCB: polychlorinated biphenyl
RAD: radiological
RCRA: Resource Conservation and Recovery Act
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] LCFs per km of urban travel
[b] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[c] Lifetime estimated total LCFs

Table 5.4.9–8. Doses to Crew and Public Under the Expanded Operations Alternative

CARGO	ANNUAL DOSE/TRUCK CREW (person-rem)		ANNUAL DOSE/GENERAL PUBLIC (person-rem)		ANNUAL LCFs	
	BASE YEAR[a]	EXPANDED OPERATIONS	BASE YEAR[a]	EXPANDED OPERATIONS	BASE YEAR[a]	EXPANDED OPERATIONS
NORMAL ROUTINE OPERATIONS						
RAD Materials[b]	9.8	57.0	82.4	481.1	4.5×10^{-2}	0.26
LLW	0.21	1.1	0.6	3.2	3.8×10^{-4}	2.0×10^{-3}
LLMW[c]	1.6×10^{-4}	5.9×10^{-4}	1.6×10^{-3}	6.4×10^{-3}	8.6×10^{-7}	3.4×10^{-6}
Medical Isotopes Production	0	25.4	0	73	0	4.7×10^{-2}
LLW (D&D)	0.21	0.21	0.60	0.60	3.8×10^{-4}	3.8×10^{-4}
TOTAL[d]					**4.6×10^{-2}**	**0.31**
SPECIAL PROJECT OPERATIONS/TOTAL SHIPMENTS						
TRU/MTRU[e]	0	6.4×10^{-3}	0	3.5×10^{-2}	0	2.0×10^{-5}
TRU/MTRU[e] ***(Legacy)***	0	3.2×10^{-3}	0	1.8×10^{-2}	0	1.0×10^{-5}
LLW (Legacy + ER)	0	10	0	28.8	0	1.8×10^{-2}
LLMW[c] ***(Legacy + ER)***	0	2.1×10^{-3}	0	2.1×10^{-2}	0	1.1×10^{-5}
TOTAL[d]					**0**	**1.8×10^{-2}**

Sources: DOE 1996h, SNL 1992a; SNL/NM 1997b, 1998a
Ci: curies
D&D: decontamination and decommissioning
ER: environmental restoration
kg: kilograms
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
RAD: radiological
rem: Roentgen equivalent, man
TRU: transuranic

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Shipment consists of 100 kg of depleted uranium.
[c] 1996 shipment of 7.2 x 10-6 Ci of sodium -24; Transport Index = 0.1.
[d] Lifetime estimated total fatalities from annual shipments and total special shipments
[e] 1997 shipment of americium -241, europium -152, cesium -137; Transport Index = 1.0.

Table 5.4.9–9. Truck Transportation Traffic Fatalities Under the Expanded Operations Alternative

CARGO	TRAFFIC FATALITY RATE: CREW AND GENERAL PUBLIC PER SHIPMENT (ROUND TRIP)	ANNUAL FATALITIES	
		BASE YEAR[a]	EXPANDED OPERATIONS
NORMAL ROUTINE OPERATIONS			
RAD Materials	3.5×10^{-4}	0.11	0.62
Explosives	2.9×10^{-4}	8.8×10^{-2}	0.51
Chemicals	2.1×10^{-6}	5.8×10^{-3}	5.8×10^{-3}
LLW	2.2×10^{-4}	8.8×10^{-4}	4.6×10^{-3}
Medical Isotopes Production	NA	NA	2.1×10^{-2}
LLMW (Shipments)	3.0×10^{-4}	3.0×10^{-4}	9.0×10^{-4}
LLMW (Receipts)	2.1×10^{-4}	0	2.1×10^{-4}
Hazardous Waste	2.2×10^{-4}	1.4×10^{-2}	2.5×10^{-2}
Recyclable Hazardous to California	1.5×10^{-4}	3.0×10^{-4}	6.0×10^{-4}
Recyclable Hazardous to New Mexico	1.6×10^{-6}	9.6×10^{-6}	1.8×10^{-5}
Solid Waste	2.6×10^{-6}	1.3×10^{-4}	1.3×10^{-4}
D&D Hazardous Waste TSCA-PCBs	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}
D&D Hazardous Waste TSCA-Asbestos	2.2×10^{-5}	3.1×10^{-4}	3.1×10^{-4}
Biohazardous Waste	1.4×10^{-4}	1.4×10^{-4}	1.4×10^{-4}
Recyclable D&D Hazardous Waste	1.6×10^{-6}	3.5×10^{-5}	3.5×10^{-5}
Recyclable Nonhazardous Solid Waste	1.6×10^{-6}	1.2×10^{-4}	1.2×10^{-4}
Nonhazardous Landscaping Waste	2.6×10^{-6}	NA	3.7×10^{-4}
Construction and Demolition Solid Waste	2.6×10^{-6}	NA	1.6×10^{-3}
RCRA Hazardous Waste (Receipt)	6.7×10^{-7}	8.0×10^{-6}	1.7×10^{-5}
Low Level Waste (D&D)	2.2×10^{-6}	8.8×10^{-4}	8.8×10^{-4}
TOTAL[b]		**0.22**	**1.2**
SPECIAL PROJECT OPERATIONS			
TRU/MTRU	1.9×10^{-5}	0	3.8×10^{-5}
TRU/MTRU (Legacy)	1.9×10^{-5}	0	3.8×10^{-5}
LLW (Legacy)	2.2×10^{-4}	0	1.2×10^{-2}
LLMW (Legacy)	3.0×10^{-4}	0	2.4×10^{-3}
LLW (ER)	2.2×10^{-4}	0	3.0×10^{-2}

Table 5.4.9–9. Truck Transportation Traffic Fatalities Under the Expanded Operations Alternative (concluded)

CARGO	TRAFFIC FATALITY RATE: CREW AND GENERAL PUBLIC PER SHIPMENT (ROUND TRIP)	ANNUAL FATALITIES	
		BASE YEAR[a]	EXPANDED OPERATIONS
LLMW (ER)	$3.0x10^{-4}$	0	$1.5x10^{-3}$
Hazardous Waste (ER)	$2.2x10^{-4}$	0	$2.5x10^{-2}$
Nonhazardous Solid Waste (ER)	$2.6x10^{-6}$	0	$2.3x10^{-5}$
TOTAL[b]		**0**	**$7.1x10^{-2}$**

Sources: SNL/NM 1997b, 1998a
D&D: decontamination and decommissioning
ER: environmental restoration
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
NA: not applicable
PCB: polychlorinated biphenyl
RAD: radiological
RCRA: *Resource Conservation and Recovery Act*
TRU: Transuranic
TSCA: *Toxic Substances Control Act*
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Lifetime estimated total traffic fatalities from annual shipments

Table 5.4.9–10. Dose Risk to Population Due to Transportation Radiological Accident, Maximum Annual Radiological Accident Risk for Highway Shipments

CARGO	ANNUAL DOSE RISK TO POPULATION person-rem		LCFs	
	BASE YEAR[a]	EXPANDED OPERATIONS	BASE YEAR[a]	EXPANDED OPERATIONS
NORMAL ROUTINE OPERATIONS				
Radioactive[b]	2.3	13.5	$1.2x10^{-3}$	$6.8x10^{-3}$
LLW	$2.3x10^{-3}$	$1.2x10^{-2}$	$1.2x10^{-6}$	$6.0x10^{-6}$
LLMW[c]	$4.6x10^{-11}$	$1.7x10^{-10}$	$2.3x10^{-14}$	$8.5x10^{-14}$
Medical Isotopes Production	0	$5.2x10^{-2}$	0	$3.0x10^{-5}$
LLW (D&D)	$2.3x10^{-3}$	$2.3x10^{-3}$	$1.2x10^{-6}$	$1.2x10^{-6}$
TOTAL[d]			**$1.2x10^{-3}$**	**$6.8x10^{-3}$**
SPECIAL PROJECT OPERATIONS/TOTAL SHIPMENTS				
TRU/MTRU[e]	0	$9.6x10^{-8}$	0	$4.8x10^{-11}$
TRU/MTRU[e] ***(Legacy)***	0	$4.8x10^{-8}$	0	$2.4x10^{-11}$
LLW (Legacy+ER)	0	0.11	0	$5.5x10^{-5}$
LLMW[e] ***(Legacy+ER)***	0	$6.0x10^{-10}$	0	$3.0x10^{-13}$
TOTAL[d]			**0**	**$5.5x10^{-5}$**

Sources: DOE 1996a, SNL 1992a, SNL/NM 1998a
D&D: decontamination and decommissioning
ER: environmental restoration
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
rem: roentgen equivalent, man
TRU: transuranic
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Shipment consists of 100 kg of depleted uranium.
[c] 1996 shipment of 7.2×10^{-6} Ci of sodium -24; Transport Index - 0.1.
[d] Lifetime estimated LCFs
[e] 1997 shipment of americium -241, europium -152, cesium -137; Transport Index = 1.0

tractor-trailer containing 40,000 ft^3 of hydrogen. Based on the results presented in Appendix F, Table F.4–1, the hydrogen explosion would result in structural damage to buildings up to a distance of 91 m from the truck. Fatalities would result up to a distance of 15 to 18 m from the truck, while eardrum ruptures would occur up to a distance of 36 m from the truck.

5.4.10 Waste Generation

The implementation of the Expanded Operations Alternative would not result in any major changes in the types of waste streams generated onsite. However, waste generation activities would increase overall if each facility were to operate at total production capacity. These increased waste volumes would be partially offset by increased waste minimization and pollution prevention programs, which project a 33-percent overall decrease in total waste disposal needs by FY 2000. The waste projections used for analysis did not take credit for potential waste minimization techniques that have not yet been implemented. Regardless, the increased generation activities would not exceed existing waste management disposal capacities.

For projection purposes, the baseline waste generation data were considered to be constant for existing facilities, with no major increases or decreases in the amount of wastes generated. Operations waste are considered to be derived from missions-related work. Nonoperations waste are generated from special programs. New operations are discussed separately in order to show the maximum existing operational increases that could be expected. Waste generation levels for special program waste, such as for the ER Project, are derived separately from the representative facilities projections under special operations. The waste quantities projected, listed in Table 5.4.10–1, represent a site-wide aggregate of quantities for each type of waste stream from existing selected facilities. As appropriate, the balance of operations (not selected facilities or special projects) waste generated is discussed within the individual waste sections. Units shown for each waste type are based on how industrial facilities charge commercial clients for disposal of these wastes.

5.4.10.1 Radioactive Wastes

Under the Expanded Operations Alternative, SNL/NM would potentially generate LLW, LLMW, and TRU and MTRU waste. However, SNL/NM would not generate any high-level waste. Projections for waste generation at selected facilities from new and existing operations are shown in Appendix H.

Existing Operations

Under the Expanded Operations Alternative, SNL/NM anticipates a maximum 61 percent increase in the generation of LLW from existing operations at selected facilities over the next 10 years. LLW generated by SNL/NM is and will continue to be transported offsite to appropriate DOE-approved disposal facilities, such as the NTS. Similarly, LLMW generation would increase by 49 percent for existing operations at selected facilities through 2008. Under the *Resource Conservation and Recovery Act Part B, Permit Application for Hazardous Waste Management Units* (SNL/NM 1996a), some treatment of the hazardous component of LLMW could be performed at SNL/NM (Table 4.12–2). LLMW for which no onsite treatment is available would be shipped offsite for treatment and disposal. SNL/NM also projects that approximately 0.59 m^3 of TRU waste would be generated annually. The existing TRU/MTRU wastes stored onsite, as well as future TRU/MTRU wastes, would be transferred to LANL for certification, prior to their disposal at the WIPP as indicated in the Waste Management Programmatic Environmental Impact Statement (DOE 1997i) ROD (DOE 1998n). Projected MTRU waste generated would increase 100 percent to a level of 0.91 m^3 annually. Existing SNL/NM operations would use less than 1 percent annually of the available radioactive waste storage capacity. This would be a minimal impact.

The DOE anticipates that MESA Complex operations would generate 0.1 ft^3 of low-level waste each year. If implemented, this would be of minimal impact.

New Operations

SNL/NM anticipates a maximum of 181 m^3 of LLW would be generated from new operations annually over the next 10 years. The majority of the increase would be due primarily to the full implementation of the medical isotopes production operations in 2003. These operations, described in the *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement* (DOE 1996b), would account for more than 83 percent of the total projected LLW under the Expanded Operations Alternative. However, due to the nature of the waste, it would be managed at the generation facility to minimize worker exposure until disposal offsite. LLMW generation from all new onsite sources would be a maximum of 7.31 m^3 annually through 2008.

SNL/NM does not expect to generate TRU and MTRU wastes from new operations. Approximately 399 kg of

Table 5.4.10–1. Waste Generation for Existing Selected SNL/NM Facilities Under the Expanded Operations Alternative

ALL WASTE		UNIT	BASE YEAR[a]	EXPANDED OPERATIONS ALTERNATIVE[b]
RADIOACTIVE WASTE				
Low-Level Waste (500 kg/m³)	Existing Operations	m³(kg)	16(8,000)	26(13,000)
	New Operations	m³(kg)	4(2,000)	181(90,500)
	SNL/NM Balance of Operations	m³(kg)	74(37,000)	74(37,000)
	SNL/NM Total LLW	m³(kg)	94(47,000)	280(140,000)
	Percent change	m³(kg)	0.0%	197.9%
Low-Level Mixed Waste (550 kg/m³)	Existing Operations	m³(kg)	3.85(2,120)	5.75(3,160)
	New Operations	m³(kg)	0.20(110)	1.27(700)
	SNL/NM Balance of Operations	m³(kg)	0.28(150)	0.28(40)
	SNL/NM Total LLMW	m³(kg)	4.33(2,380)	7.31(3,900)
	Percent change	m³(kg)	0.0%	68.7%
TRU Waste (310 kg/m³)	Existing Operations	m³(kg)	-	0.59(180)
	New Operations	m³(kg)	-	0.14(40)
	SNL/NM Balance of Operations	m³(kg)	-	-
	SNL/NM Total TRU	m³(kg)	-	0.74(210)
MTRU Waste (76 kg/m³)	Existing Operations	m³(kg)	0.45(34)	0.91(70)
	New Operations	m³(kg)	-	0.14(10)
	SNL/NM Balance of Operations	m³(kg)	-	-
	SNL/NM Total MTRU	m³(kg)	0.45(34)	1.05(80)
	Percent change		0.0%	131.3%
RADIOACTIVE WASTE TOTAL[c]	**Existing Operations**	**m³(kg)**	**20.34 (10,154)**	**33.06(16,550)**
	New Operations	**m³(kg)**	**4.62(2,110)**	**182.41(91,450)**
	SNL/NM Balance of Operations	**m³(kg)**	**73.92 (37,150)**	**73.92(37,050)**
	SNL/NM Total Radioactive Waste	**m³(kg)**	**98.88 (49,414)**	**289.39(145,050)**
	Percent change		**0.0%**	**192.7%**

Table 5.4.10–1. Waste Generation for Existing Selected SNL/NM Facilities Under the Expanded Operations Alternative (concluded)

ALL WASTE	UNIT	BASE YEAR[a]	EXPANDED OPERATIONS ALTERNATIVE[b]
RCRA HAZARDOUS WASTE			
Existing Operations (with MESA)[b]	kg	16,187	25,074 (26,274)[b]
New Operations	kg	398	2,337
SNL/NM Balance of Operations	kg	39,267	64,902
SNL/NM Total RCRA Hazardous (with MESA)[b]	kg	55,852	92,314 (93,514)[b]
	m^3	44.3	73.2
Percent Change		0.0%	65.3%
SOLID WASTE			
SNL/NM Total Solid Waste[d,e]	m^3(kg)	2,022 (0.6M)	2,022 (0.6M)
Percent Change		0.0%	0.0%
WASTEWATER			
Existing Operations (with MESA)[b]	M gal	49	85.5 (89.3)[b]
New Operations	M gal	0	5
SNL/NM Balance of Operations	M gal	231	231
SNL/NM Total Wastewater (with MESA)[b]	M gal	280	322 (325)[b]
Percent Change		0.0%	15%

Sources: SNL/NM 1998a, 1997b, 1998c, 1998t
ft3: cubic feet
kg: kilogram
LLMW: low-level mixed waste
LLW: low-level waste
M: million
M gal: million gallons
m^3: cubic meters
MESA: Microsystems and Engineering Sciences Applications
MTRU: mixed transuranic
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] If implemented, MESA would become operational after 2003, and hazardous waste and wastewater would increase by 1,200 kg per year and 3.8 M gals per year, respectively.
[c] Numbers are rounded and may differ from calculated values.
[d] Individual breakdowns of solid waste for existing, new, and balance of operations are unavailable because of tracking methods.
[e] The addition of MESA would not increase solid waste generation, in part, because there would be no new employees.
Note: MESA operations would generate minimal amounts of low-level waste (0.1 ft3 per year), which the table does not reflect.

spent fuel would be generated over the 10-year period. Spent fuel is further discussed in Appendix A as a material resource.

Balance of Operations

The waste generation level for the balance of operations was determined for each type of radioactive waste (Table 5.4.10–1). Only LLW and LLMW would be affected. Balance of operations mission operations at SNL/NM would account for an additional 74 m^3 per year of LLW. These same operations would account for an additional 0.28 m^3 of LLMW per year. The overall operations impacts for this alternative would increase by approximately 198 percent for LLW and 69 percent for LLMW.

Current Capacity

Previously generated radioactive wastes (legacy waste) occupy approximately 494 m^3 of the available 11,866 m^3 of total radioactive waste storage capacity at the RMWMF and its associated storage areas. This represents approximately 4.2 percent of the total available capacity. Therefore, there would be sufficient capacity to accommodate the anticipated increases in radioactive wastes.

Special Projects

Projections indicate that the ER Project, a special project beyond the scope of existing operations, will be the single largest waste generator at SNL/NM in 1998. Before it ends, the ER Project would produce approximately 2,862 m^3 of LLW and 221 m^3 of LLMW, primarily contaminated soil and debris. Projected ER Project radioactive waste volumes are listed in Table 5.3.10–2. ER Project wastes are stored and handled at the point of generation prior to offsite disposal. Management of ER Project waste would not be expected to impact overall SNL/NM waste management operations. The DOE expects actual cleanup to be completed between FY 2003 and FY 2005, with ER waste disposed of before the end of the project. ER Project waste must be properly characterized. Therefore, lag time is built into the project schedule between field remediation and actual disposal of waste.

5.4.10.2 Hazardous Waste

Existing Operations

As shown on Table 5.4.10–1, under the Expanded Operations Alternative, SNL/NM anticipates an increase in the generation of RCRA hazardous waste from existing operations from 16,187 kg in the base year to 25,074 kg per year. If the MESA Complex configuration is implemented, it would become operational after 2003; an additional 1,200 kg per year of hazardous waste would be generated. Projections for selected facilities for new and existing operations are shown in Appendix H. Projected RCRA hazardous waste generation is presented in Figure 4.12–4.

No appreciable change in the generation of explosive waste would occur. Therefore, the TTF, with a treatment capacity of 9.1 kg of waste per burn, would continue to accommodate those wastes generated from the Light-Initiated High Explosive Facility at SNL/NM. The majority of explosive waste would be disposed of at SNL/NM or through KAFB.

New Operations

SNL/NM anticipates annual generation of a maximum of 2,337 kg of hazardous waste by new operations over the next 10 years. The majority of the increase would be primarily due to the full implementation of medical isotopes production operation, associated with the MIPP in 2003. These operations, described in the *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement* (DOE 1996b), would account for less than 3 percent (2.5 percent) of the total projected hazardous waste generation under the Expanded Operations Alternative.

New SNL/NM operations would use less than 1 percent annually of the available hazardous waste storage capacity, which is considered to be a minimal impact.

Balance of Operations

It was assumed that the RCRA hazardous waste levels for the balance of operations at SNL/NM would increase by the same proportion as RCRA waste for selected facilities, because selected facilities represent the overall plant. Consequently, multipliers were used to project RCRA hazardous waste levels under all three alternatives. In the base year, balance of operations generated 39,267 kg of RCRA hazardous waste. For the Expanded Operations Alternative, the maximum projected balance of operations amount would be 64,902 kg.

Current Capacity

Under the Expanded Operations Alternative, the total volume of hazardous waste generated at SNL/NM requiring offsite disposal at licensed/approved facilities, would not exceed the existing 286.5 m^3 of storage and handling capacities at the HWMF and its associated storage buildings. The outside nonpermitted bermed storage area for nonhazardous waste was not included in the onsite storage capacity calculations. SNL/NM routinely ships hazardous waste to various offsite commercial disposal facilities. Projections provide that a maximum of 26 percent of the existing hazardous waste capacity would be used. Most, if not all, waste would be shipped in less than 1 year to meet regulatory requirements. Based on these projections and on continued operations at selected facilities under the Expanded Operations Alternative, the hazardous waste generation impacts would continue to be minimal.

Special Projects

During field remediation, the ER Project would be the single largest waste generator at SNL/NM and would produce approximately 26 M kg of hazardous waste by 2002. Final disposal would be accomplished by 2004. Projected ER hazardous waste volumes are presented in Table 5.3.10–2. ER waste handling is discussed in Section 4.12.3.3.

D&D operations would continue (as outlined in Section 2.3.5). This program would directly impact the quantity of TSCA hazardous waste requiring disposal. Under this modernization program, SNL/NM would continue to generate TSCA hazardous waste, primarily PCBs and asbestos that are removed from transformers and buildings. Since the main PCB relamping and transformer removal has been completed, quantities of TSCA waste have dropped to approximately 122,000 kg per year and should remain at that level (Figures 4.12–5 and 4.12–6).

The total volume of TSCA waste would eventually decrease as the targeted facilities are removed. Currently, SNL/NM has 674 buildings providing a total of 5 M gross ft^2 of office and operational space. Through this facility modernization program, the number of buildings would be reduced to 465, totaling approximately 4.9 M gross ft^2. This program would remove 138 buildings accounting for 179,204 gross ft^2 within FY 1998 and FY 1999 at SNL/NM. During FY 2000 through FY 2002, 49 additional buildings, accounting for 108,937 gross ft^2, are potentially scheduled for removal. Over the long term, an additional 29 buildings would be removed with a total of 84,132 gross ft^2. To make up for the loss of office and operational space, seven additional buildings would be built, adding a total of approximately 240,000 gross ft^2.

If implemented, the MESA Complex configuration would result in the decontamination, decommissioning, and demolition of the CSRL. The resulting wastes could include 1 ton of asbestos (1 ton is approximately 2.5 cubic yards), 0.5 ton of PCB ballasts, 0.5 ton of hazardous waste, 0.1 ton of nonhazardous waste, and 2,000 tons of demolition debris. This would occur after MESA became operational (after 2003).

No predictions are made for years beyond 2007.

5.4.10.3 All Other Wastes

All SNL/NM operations also involve four additional waste management activity areas, discussed below.

Biohazardous (Medical) Waste

The total volume of medical waste would generally remain a function of the total number of full-time employees and subcontractors at SNL/NM. In 1997, 2,463 kg of medical waste were disposed of at an approved offsite commercial facility. Under the Expanded Operations Alternative, approximately 4,071 kg of medical waste would be generated. The existing waste handling capabilities would be adequate to accommodate this waste. No additional offsite impacts would occur, because offsite disposal capacity would continue to be sufficient.

Nonhazardous Chemical Waste

In 1998, the ER Project will generate approximately 125,112 kg of nonhazardous waste (Table 5.3.10–2). The maximum quantity of nonhazardous waste generated annually at SNL/NM and managed by the HWMF would be 114,576 kg, based on the waste multiplier (see Appendix H) developed for RCRA hazardous waste (Rinchem 1998a). Existing commercial disposal facilities would still have adequate capacities to handle the continued generation of nonhazardous waste, thus no additional impacts would be anticipated.

Municipal Solid Waste

Site-wide solid waste generation trends at SNL/NM would generally remain a function of total building area and the number of full-time and subcontractor employees. This function is based on general build operations activities, such as maintenance and cleaning, and, to a lesser extent, the general office waste created by SNL/NM employees. Despite the projected 10 percent personnel increase, no appreciable onsite impacts to disposal facilities would be anticipated because existing waste handling capabilities are already in place. As existing buildings are replaced, personnel are moved to make more efficient use of the space. No additional offsite impacts would occur, because offsite disposal capacity would continue to be sufficient. However, a significant amount of C&D waste, a special class of solid waste, would potentially be generated under the facility modernization program described above. Quantities of C&D waste associated with the facility modernization program projected to be similar to prior years. This waste is disposed of at KAFB and does not currently create an offsite impact.

Table 5.3.10–3 summarizes construction debris disposal. If implemented, the MESA Complex configuration would become operational after 2003; demolition of the CSRL could result in 2,000 tons (5,000 cubic yards) of additional debris.

Wastewater

Under the Expanded Operations Alternative, increases in process and domestic water use would occur throughout SNL/NM due to varying levels of operation within each facility. SNL/NM would generate approximately 322 M gal of wastewater annually. If MESA becomes operational after 2003, an additional 3.8 M gals of wastewater would be generated. However, SNL/NM entered into an MOU with KAFB, the DOE, the city of Albuquerque, and the state of New Mexico to reduce its water use by 30 percent by 2004 (SNL/NM 1997p). The MDL would be the single facility discharging the largest wastewater volume at SNL/NM. Reduction efforts would focus on the MDL to reduce the amount of process wastewater being generated. See Section 5.3.2 for additional discussion of wastewater quantities and capacities.

5.4.11 Noise and Vibration

Projections of the number of impulse noise tests under the Expanded Operations Alternative indicate a 250 percent increase in tests over those of the 1996 baseline 73.2 number and a 184 percent increase above No Action Alternative levels. These test activities originate from facilities located in TA-III and the Coyote Test Field and are remote from other SNL/NM TAs and the site boundary. There would be no increase in the magnitude of explosions during test activities that would result in a larger impulse noise for the Expanded Operations Alternative.

The level of impulse noise activities under the Expanded Operations Alternative would be an average of approximately one impulse noise event per hour for an 8-hour work day and a 261-day work year. Only a small fraction of these tests would be of sufficient magnitude to be heard or felt beyond the site boundary. The vast majority of tests would be expected to be below background noise levels for receptor locations beyond the KAFB boundary and would, therefore, be unnoticed by those neighborhoods bounding the site. Building damage is sometimes blamed on ground vibrations caused by explosive detonations, whereas the damage is often the result of the traveling pressure waves. The impulse noise levels resemble a dull thud and generally are considered an annoyance because of "startle" effects, including window vibrations. The effects on the public would be minor. Ground vibrations would remain confined to the immediate test area within the ground hazard area.

If implemented, operations under the MESA Complex configuration would have a negligible effect on background noise levels and would not increase the number of impulse noise events. Noise levels would increase temporarily during construction due to the operation of heavy equipment such as air compressors and, cement mixers, and to construction vehicle traffic.

5.4.12 Socioeconomics

Implementation of the Expanded Operations Alternative would result in no appreciable impacts to demographic characteristics, economy, and community services in the ROI, as discussed below. The discussion of impacts is based on a bounding economic analysis based on projections in *SNL/NM Facility Source Documents* (SNL/NM 1998a) and potential indirect increases across all SNL/NM facilities, as discussed in Section 5.2.13.

5.4.12.1 Demographic Characteristics

The Expanded Operations Alternative would not be likely to have any noticeable change in existing demographic characteristics within the ROI (Section 4.14.3). Under this alternative, overall expenditures and employment at SNL/NM would expand gradually at a steady rate through 2008.

5.4.12.2 Economic Base

The Expanded Operations Alternative would not be likely to have a noticeable change in the existing economic base in the ROI (Section 4.14.3). Historically, increases or decreases in operational levels of activities at SNL/NM have been gradual and/or fluctuated about 1 or 2 percent per year (SNL/NM 1997a). Under this alternative, overall expenditures and employment at SNL/NM would expand at a gradual steady rate through 2008.

Table 5.4.12–1 presents an estimate of the Expanded Operations Alternative impacts on the ROI economy from a 10-percent increase in operational levels of activity and associated increases in expenditures, income, and employment, both direct and indirect, at SNL/NM. Operational activities associated with selected facilities are included in the totals presented in the table. If operations at SNL/NM were to increase by 10 percent over current levels, overall economic activity within the ROI would be expected to increase by about 0.8 percent, with slightly smaller increases in income and employment at about 0.7 percent. As presented in Table 5.4.12–1, a 10-percent increase in operational levels of activity at SNL/NM through 2008 would help generate $4.33 B in economic activity out of a total ROI activity of $42.8 B, contribute $1.17 B in income out of a total ROI income level of $13.51 B, and represent 29,123 jobs out of a total of 334,446 jobs within the ROI.

If implemented, the MESA Complex configuration would be constructed adjacent to the existing MDL. Construction would start in FY 2001 and end in FY 2003. Projected construction costs would be $48 M, $110 M, and $94 M in 2001, 2002, and 2003, respectively. Construction of the facility would be likely to employ several hundred short-term workers and probably would result in a small temporary increase in local employment. A substantial portion of the dollars spent for the materials would flow through the wholesale and retail trade sectors of the regional economy. This facility would employ an estimated 500 to 550 workers. Employees working in existing facilities would relocate to MESA, so the hiring of new employees would be unlikely.

Table 5.4.12–1. SNL/NM's Impact on Central New Mexico's Economy if Operations Were to Increase by 10 Percent

ECONOMIC MEASURE	FY 1996[a]			ASSUMING A 10% INCREASE IN OPERATIONS			
	SNL/NM	TOTAL ROI	PERCENT OF ROI	SNL/NM	TOTAL ROI	PERCENT OF ROI	PERCENT CHANGE
ECONOMIC ACTIVITY ($ BILLIONS)							
Direct Expenditures	1.43			1.57			
Indirect & Induced	2.50			2.75			
TOTAL ECONOMIC ACTIVITY	**3.93**	**42.40**	**9.3**	**4.32**	**42.80**	**10.1**	**0.8**
Economic Activity Multiplier: 2.75[b]							
INCOME ($ BILLIONS)							
Net Wages & Salaries	0.48			0.53			
Indirect & Induced	0.58			0.64			
TOTAL INCOME	**1.06**	**13.40**	**7.9**	**1.17**	**13.51**	**8.7**	**0.8**
Income Multiplier: 2.21[b]							
EMPLOYMENT (NUMBER OF EMPLOYEES)							
SNL/NM Employment	7,652			8,417			
Indirect & Induced	18,826			20,706			
TOTAL EMPLOYMENT	**26,478**	**331,800**	**8**	**29,123**	**334,446**	**8.7**	**0.7**
Employment Multiplier: 3.46[b]							

Source: DOE 1997j
FY: fiscal year
ROI: region of influence

[a] Modeled results from DOE 1997j
[b] The use of multipliers in calculating economic impacts in the ROI is explained in Section 4.14.3.

Section 6.4.11 discusses the cumulative impact of the Expanded Operations Alternative within the ROI and the expected growth from other industrial and economic sectors.

5.4.12.3 Housing and Community Services

The Expanded Operations Alternative would not create a noticeable change in existing housing and community services within the ROI (Section 4.14.3). Under this alternative, overall expenditures and employment at SNL/NM would expand at a steady rate through 2008; however, the contributory effects from other industrial and economic sectors within the ROI would be greater than SNL/NM's (Section 6.4.11).

5.4.13 Environmental Justice

In general, SNL/NM operations under the Expanded Operations Alternative would have no known disproportionately high or adverse health or environmental impacts on low-income or minority populations within the ROI. One area of concern is water resources and hydrology. Anticipated water resources adverse impacts would equally affect all communities in the area (see Section 5.4.4). Thus, no disproportionately high and adverse impacts to minority and low-income communities would be anticipated for this resource area.

The DOE does not expect the MESA Complex configuration to create an environmental justice-related impact, based on the MESA-related impacts presented in Section 5.4 and the ROI evaluated for the Expanded Operations Alternative.

Table 5.4.13–1 provides a brief summary of impacts for each resource or topic area under the Expanded Operations Alternative. It also identifies areas where the impacts do not vary from the No Action Alternative. See Section 5.3.13 for an expanded discussion of environmental justice issues by resource area.

Table 5.4.13–1. Summary of Potential Environmental Justice Impacts Under the Expanded Operations Alternative

RESOURCE OR TOPIC AREA	SUMMARIZED EFFECT	EFFECT ON RESOURCE OR TOPIC AREA ROI	PROPORTIONAL EFFECT ON	
			LOW-INCOME	MINORITY NEIGHBOR-HOODS
Land Use and Visual Resources, Infrastructure, Geology and Soils, Biological and Ecological Resources, Cultural Resources, Waste Generation	Same as under the No Action Alternative	Same as under the No Action Alternative	Same as under the No Action Alternative	Same as under the No Action Alternative
Water Resources and Hydrology	SNL/NM groundwater use is projected to account for 12% of local aquifer drawdown.	Adverse effect	Not adverse effect	Not adverse effect
Air Quality Nonradiological Air	Emissions would be below the most stringent standards, which define the pollutant concentrations below which there are no adverse impacts to human health and the environment. Concentrations would be below regulatory standards and human health guidelines. SNL/NM carbon monoxide emissions would account for 6.3% of Bernalillo county carbon monoxide emissions.	Not adverse	Not adverse	Not adverse
Air Quality Radiological Air	MEI 0.51: mrem/yr Collective ROI dose: 15.8 person-rem/yr Average collective ROI dose: 2.16×10^{-2} mrem/yr	Not adverse	Not adverse	Not adverse
Human Health and Worker Safety	MEI lifetime risk of fatal cancer increases by 2.6×10^{-7} Fatal cancers (additional ROI): 7.9×10^{-3} Risk of cancer fatality to workforce is 7.6×10^{-3}	Not adverse	Not adverse	Not adverse
Transportation	Total annual material shipments: 6,303 Total KAFB traffic (daily vehicles): 39,085 Incident-free exposure, truck emissions - annual LCFs: 6.2×10^{-2} Incident-free exposure, dose - annual LCFs: 0.31	Not adverse	Not adverse	Not adverse

Table 5.4.13–1. Summary of Potential Environmental Justice Impacts Under the Expanded Operations Alternative (concluded)

RESOURCE OR TOPIC AREA	SUMMARIZED EFFECT	EFFECT ON RESOURCE OR TOPIC AREA ROI	PROPORTIONAL EFFECT ON	
			LOW-INCOME	MINORITY NEIGHBOR-HOODS
Noise and Vibration	Four-fold increase in test activities over 1996 levels, an average of less than one impulse noise event per hour for an 8-hour work day and a 261-day work year. Only a fraction of these tests would be of sufficient magnitude to be heard or felt beyond the site boundary. The vast majority of tests would be expected to be below background noise levels for receptor locations beyond the KAFB boundary and would, therefore, be unnoticed in neighborhoods bounding the site.	Not adverse	Not adverse	Not adverse
Socioeconomics	SNL/NM employees: 8,417 SNL/NM total economic activity: $4.32 B/yr Percent of ROI total economic activity: 10.1%	Not adverse	Not adverse	Not adverse

Source: Original
B: billion
KAFB: Kirtland Air Force Base
LCF: latent cancer fatalities
MEI: maximally exposed individual
mrem: millirem
rem: Roentgen equivalent, man
ROI: region of influence
SNL/NM: Sandia National Laboratories/New Mexico
yr: year

5.5 REDUCED OPERATIONS ALTERNATIVE

Under the Reduced Operations Alternative, DOE and interagency programs and activities at SNL/NM would decrease to the minimal operations needed to maintain SNL/NM facilities and equipment in an operational readiness mode. This section describes the impacts that would result from this alternative.

5.5.1 Land Use and Visual Resources

The implementation of the Reduced Operations Alternative would not affect the existing land use patterns or visual resources at SNL/NM facilities on KAFB. Sections 5.5.1.1 and 5.5.1.2 discuss these resource areas in relation to the Reduced Operations Alternative.

5.5.1.1 Land Use

Under the Reduced Operations Alternative, there would be no additional impacts to existing land resources on KAFB. The extent of DOE land and USAF-permitted acreage currently available for use by SNL/NM facilities on KAFB would remain relatively the same. Similarly, operations would remain consistent with industrial/research park uses and would have no foreseeable effect on established land use patterns or requirements. At locations on permitted land where operations would decline or be shut down by the “owning” organization, SNL/NM would continue to hold the sites to conduct periodic safety checks and complete any ER actions (Section 5.3.3.1). Before returning the land to the USAF, SNL/NM would be responsible for conducting any demolition work and restoring the land to its condition when originally acquired (SNL 1997a).

5.5.1.2 Visual Resources

No additional impacts to visual resources would be likely to adversely change the overall appearance of the existing landscape. Efforts initiated by SNL/NM to incorporate and maintain campus-style design would continue. This style contains established principles and design guidance that provide a framework for the physical development and redevelopment of SNL/NM sites. The guidance covers building massing, facades, colors, building orientation and entries, traffic circulation corridors, standardized signage, and landscaping, including low-water-use plant selections. These efforts would be consistent with the high concern for scenery due to the numbers of observers and users in the area.

Based on the reduced levels of operation association with this alternative, activities at outdoor testing facilities in the Coyote Test Field and the Withdrawn Area would decline. Some testing activities that produce smoke and dust of variable quantity and duration would take place, but these conditions would be periodic, short-term, and would not change the visual characteristics of the area. Where decommissioning, demolition, or ER work are planned, actions would be taken such as backfilling, reducing side slopes, applying topsoil, reseeding, and establishing plant growth to restore the area to its condition when originally acquired.

5.5.2 Infrastructure

As discussed in Section 5.3.2, the infrastructure analysis looked for potential incremental changes to SNL/NM services, utilities, and facilities by alternative. The two areas where incremental changes were identified are site-wide utility demands and four selected infrastructure facilities: the steam plant, RMWMF, HWMF, and TTF. See Section 2.3 for a discussion of how the four facilities were selected for analysis.

With regard to site-wide utility demands, most SNL/NM facilities do not meter utility use. For the Reduced Operations Alternative, the lowest number reported in the No Action Alternative was used as the basis for projecting utility use. Any incremental changes between the base year and the Reduced Operations Alternative projections in utility demands for the selected facilities (see Chapter 2) were taken into account by adjusting site-wide demand accordingly as presented in Table 5.5.2–1. Facility-specific utility data are presented in Chapter 3, Table 3.6–1.

As discussed in Section 5.3.2, analysis of the selected infrastructure facilities relied on the projected throughput and operational capacities as presented in Table 5.5.2–2.

The implementation of the Reduced Operations Alternative would generally lessen the demands on infrastructure (Table 5.5.2–1). Water consumption would decrease approximately 24 M gal per year to 416 M gal per year. SNL/NM would generate approximately 268 M gal of wastewater per year. Annual electrical consumption would decline to 185,000 MWh. Small fluctuations in projected utility consumption rates would occur due to annual changes in weather.

The current infrastructure resources would be capable of accommodating SNL/NM facility requirements under the Reduced Operations Alternative. These levels of

Table 5.5.2–1. Annual[a] SNL/NM Utility Usage and Capacities Under the Reduced Operations Alternative

RESOURCE/ DATA SOURCE	BASE YEAR USAGE	REDUCED OPERATIONS ALTERNATIVE ANNUAL USAGE	SYSTEM CAPACITY	SNL/NM USAGE AS PERCENT OF CAPACITY
WATER USE[b]				
Site-wide demand[c]	440 M gal	417 M gal	2.0 B gal	21
Selected facilities[g]	0 M gal	-1.4 M gal	NA	
TOTAL	**440 M gal**	**416 M gal**	**2.0 B gal**	**21**
WASTEWATER DISCHARGE				
Site-wide demand[c]	280 M gal	265 M gal	850 M gal	31
Selected facilities[g]	0 M gal	3.3 M gal	NA	
TOTAL	**280 M gal**	**268 M gal**	**850 M gal**	**32**
ELECTRICAL USE				
Site-wide demand[c]	197,000 MWh	186,000 MWh	1,095,000[d] MWh	16
Selected facilities[g]	0 MWh	-775 MWh	NA	
TOTAL	**197,000 MWh**	**185,000 MWh**	**1,095,000[d] MWh**	**16**
NATURAL GAS USE				
Site-wide demand[c,e]	475 M ft^3	450 M ft^3	2.3 B ft^3	20
Selected facilities[g,h]	0 M ft^3	-65 M ft^3	NA	
TOTAL	**475 M ft^3**	**385 M ft^3**	**2.3 B ft^3**	**18**
MISCELLANEOUS				
Fuel oil[f,h]	7,000 gal	7,000 gal	Not limited by infrastructure	NA
Propane[h]	383,000 gal	362,000 gal	Not limited by infrastructure	NA

Sources: DOE 1997k; SNL 1997a; SNL/NM 1998a, c; USAF 1998a
B: billion
ft^3: cubic feet
FY: fiscal year
gal: gallon
M: million
MW: megawatt
MWh: megawatt hour
NA: Not applicable
psi: pounds per square inch
[a] Base Year is 1996 or 1997, the most representative of usage. Not necessarily the same as in Chapter 4.
[b] Although not accounted for in the table, SNL/NM expects to reduce water by 30 percent by the year 2004 (see Table 5.3.2–1 for conservation based scenario).
[c] Prorated based on the following M square footage: Base Year = 5.266; FY 2003 = 5.143; FY 2008 = 4.986
[d] Based on 125-MW rating
[e] Estimated based on 60 psi
[f] Fuel oil is used in emergency situations at the Steam Plant and is not dependent upon square footage.
[g] Adjustment for contribution from selected facilities as reported in SNL/NM 1998a
[h] No adjustments were reported in SNL/NM 1998a. Estimate based on 260 M ft^3 (at 14.7 psi) reduction at steam plant converted to 65 M ft^3 at 60 psi

Table 5.5.2–2. Selected (Infrastructure) Facility Annual Throughput[a] and Capacities Under the Reduced Operations Alternative

FACILITY[d]	BASE YEAR 1997	REDUCED OPERATIONS ANNUAL THROUGHPUT	SYSTEM CAPACITY ANNUAL	THROUGHPUT AS PERCENT OF CAPACITY
Steam Plant (steam produced)[e]	544 M lb	362 M lb	3.33 B lb	11
HWMF (waste handled)[e]	203,000 kg	175,000 kg	579,000 kg[c]	30
RMWMF (waste handled)[e]	1.6 M lb	0.8 M lb	2.7 M lb[c]	30
TTF (waste handled)[e]	Minimal	Minimal	7,300 lb/yr[b]	1

Source: SNL/NM 1998a
B: billion
ft^3: cubic feet
HWMF: Hazardous Waste Management Facility
kg: kilogram
lb: pound
M: million
RMWMF: Radioactive and Mixed Waste Management Facility
TTF: Thermal Treatment Facility
yr: year
[a] Throughput means the amount of steam produced or waste handled.
[b] Permit capacity
[c] This is the capacity for single-shift work with current employment level, not permit capacity.
[d] See Section 2.3 for discussion on how these facilities were selected.
[e] See Table 3.6–1, "Infrastructure" category.

support would be compatible with system requirements and less than those under the No Action Alternative. Specific details on these systems are presented in the *1998 Sites Comprehensive Plan* (SNL 1997a). KAFB utility usage is discussed in Section 6.2.

Impacts associated with the four facilities analyzed would be less than those expected under the No Action Alternative. Throughput and capacities are presented in Table 5.5.2–2. As shown in the table, ample capacity exists for the four facilities.

5.5.3 Geology and Soils

The implementation of the Reduced Operations Alternative would result in the continuation or lessening of impacts related to soil contamination and slope stability, as described in Sections 5.5.3.1 and 5.5.3.2, respectively.

5.5.3.1 Soil Contamination

Section 5.3.3 presents the methods used in evaluating soil contamination at SNL/NM. It focuses on near-surface (zero to 1 ft deep) soil contamination at SNL/NM sites, particularly those investigated under the ER Project. The DOE has committed to clean up 162 of 182 ER sites. The remaining 20 sites would be listed as active. Of concern among these active sites are outdoor testing areas where normal operations or accidents could result in the deposition of contaminants on the ground surface.

Under the Reduced Operations Alternative, the frequency of tests would be curtailed such that future soil contamination occurrences requiring cleanup would be unlikely. For example, at the Lurance Canyon Burn site, certification tests would decrease from 12 to 1 per year. Accordingly, the once-in-10-year event (contamination and cleanup of up to 7,000 μg of DU per g of soil over a 1,000-ft^2 area) might be expected to occur once every 120 years.

SNL/NM conducts immediate cleanup actions (SNL/NM 1998a) and periodic site surveys (SNL 1997e) to clean up these sites to levels that meet future land use standards.

5.5.3.2 Slope Stability

Section 5.3.3 presents the relevance of and methods used to evaluate slope stability. Four areas were selected for a detailed, qualitative evaluation: the southern boundary of TA-IV, the Aerial Cable Facility, the Lurance Canyon Burn Site, and the Electro-Explosive Research Facility. Slope failure at these locations would be remote.

Under the Reduced Operations Alternative, no changes in activity types or frequencies would be projected for TA-IV and the Electro-Explosive Research Facility (SNL/NM 1998a). A decrease in testing would be expected at the Aerial Cable Facility and the Lurance Canyon Burn Site (SNL/NM 1998a). No slope destabilizing activities have been identified at the Lurance Canyon Burn Site. Accidental burns of vegetation from hot missile debris could become less frequent at the Aerial Cable Facility, although no evidence of slope instability has been observed from a previous burn. The likelihood of slope failure resulting from SNL/NM activities would continue to be remote under this alternative.

5.5.4 Water Resources and Hydrology

Impacts from the implementation of the Reduced Operations Alternative would not differ substantively from the impacts described in Section 5.3.4 for the No Action Alternative. Impacts to groundwater quality and quantity and surface water quality and quantity are described in Sections 5.5.4.1, 5.5.4.2, 5.5.4.3, and 5.5.4.4, respectively.

5.5.4.1 Groundwater Quality

Section 5.3.4 identifies sources of groundwater contamination and presents modeling of the CWL. All groundwater quality impacts described in Section 5.3.4.1 would be alternative-independent—the Reduced Operations Alternative would not cause any change in the nature or extent of groundwater contamination. Contamination of groundwater would remain an adverse impact as discussed in Section 5.3.4.1. No changes in rate and scope of ER Project remediation activities are projected under the Reduced Operations Alternative.

5.5.4.2 Groundwater Quantity

Using the groundwater quantity analysis described in Section 5.3.4.2 and the projected SNL/NM water use from 1998 to 2008 under the Reduced Operations Alternative, 571 M ft^3 of water would be withdrawn over the 10-year operational period, in comparison to 605 M ft^3 under the No Action Alternative. Both these amounts account for approximately 11 percent of the projected 5,326 M ft^3 of groundwater withdrawal in the KAFB vicinity from 1998 to 2008. The SNL/NM water use for either alternative, therefore, corresponds to 11 percent of this projected withdrawal.

The impacts described in Section 5.3.4.2 would not vary in any significant manner under the Reduced Operations Alternative. Aquifer drawdown would remain an adverse impact.

5.5.4.3 Surface Water Quality

SNL/NM impacts to surface water quality are discussed in the No Action Alternative (Section 5.3.4). This discussion compares results of water quality analyses in Tijeras Arroyo (from samples collected during storm events) near the downstream boundary of KAFB, with NMWQCC stream standards. No constituents in the analyses exceeded these standards. Further, the three major potential contributors to surface water contamination (ER Project sites; permitted storm water discharges from TAs-I, -II, and -IV; and outdoor testing facilities) were evaluated based on potential contaminants and likelihood of migration.

Under the Reduced Operations Alternative, the following two changes could occur in the major potential contributors to surface water contamination:

- A projected 5 percent decrease in staff below current levels (Section 5.5.12) could potentially reduce the quantity of oil and grease runoff from permitted storm water discharges in TAs-I, -II, and -IV. The most recent storm water monitoring shows oil and grease concentrations ranging from 0.60 to 1.4 mg/L (SNL 1997a). Although there are no quantitative NPDES or state limits for oil and grease, these concentrations are near detection limits. A further reduction would have no deleterious effects.
- A reduction in the frequency of outdoor tests could result in a decrease of radioactive materials deposited on the ground surface. To date, surface water sampling has not shown evidence of contamination resulting from tests; reducing the frequency of outdoor tests would further reduce the likelihood of such contamination. Therefore, concentrations of radionuclides at the exit point of Tijeras Arroyo from KAFB would be anticipated to remain substantially the same under the Reduced Operations Alternative.

5.5.4.4 Surface Water Quantity

The method used to estimate the SNL/NM contribution to surface water quantity is described in Section 5.3.4 and in Appendix B. The analysis calculates the quantities of excess surface water runoff from developed areas of SNL/NM, and the discharge of process and sanitary water to Albuquerque's Southside Water Reclamation Plant. Under the No Action Alternative, the estimated total excess surface water contribution to the Rio Grande would be between 40.7 and 41.3 M ft^3 annually. The vast majority of this contribution (40.6 M ft^3) would be from discharge to the water reclamation plant.

Storm Water Runoff

Under the Reduced Operations Alternative, only minor net differences in building and parking lot areas would be likely. These differences would not significantly change the developed (impervious) area of SNL/NM from the 0.72-mi^2 area projected under the No Action Alternative. Therefore, excess storm water runoff would continue at 100,000 to 700,000 ft^3 per year, as estimated under the No Action Alternative (Appendix B).

Discharge to Sanitary Sewer

The estimated annual volume of water to be discharged to the sanitary sewer under the Reduced Operations Alternative would be 35.8 M ft^3 (268 M gal), 13 percent less than under the No Action Alternative (Section 5.3.4). Combined with the excess storm water runoff, the total estimated SNL/NM effect on surface water quantity would be between 35.9 and 36.5 M ft^3 annually. This would represent approximately 0.06 percent of Rio Grande flow at the discharge points. Under the Reduced Operations Alternative, no detrimental effects to the Rio Grande from the quantity of SNL/NM water discharged would be likely.

5.5.5 Biological and Ecological Resources

Impacts to biological and ecological resources resulting from implementation of the Reduced Operations Alternative would be similar to those under the No Action Alternative. There would be slightly decreased levels of noise and activity under this alternative. Impacts to biological and ecological resources would be minimal. Inventory and management of the biological resources by SNL/NM, KAFB, and the USFS would continue to protect the animals, plants, and sensitive species on KAFB.

Outdoor activities would result in a slight decrease in the probability of unintended fires, off-road traffic, noise, small explosive debris, and plumes of smoke. The decreased level of activity would be unlikely to cause the loss of any known species or plant community at KAFB. The area of vegetation disturbed would be decreased, and the effect on the viability of plant communities would be negligible.

Under the Reduced Operations Alternative, there would be no effect to the Federally endangered peregrine falcon, as discussed in Section 5.3.5. It is not anticipated that there would be adverse effects to the viability of populations of any sensitive species.

Potential contaminant loads due to this alternative impacting plants and animals would be expected to be smaller than under the No Action Alternative and continue to be negligible based on annual ecological monitoring data (SNL/NM 1997u). See Section 5.5.3 for a discussion of contaminant loads and geology and soils impacts.

5.5.6 Cultural Resources

Implementation of the Reduced Operations Alternative would have low to negligible impacts to cultural resources due to 1) the absence of cultural resource sites on DOE-administered land, 2) the nature of the cultural resources found in the ROI (see Appendix C), 3) compliance with applicable regulations and established procedures for the protection and conservation of cultural resources located on lands administered by the DOE and on lands administered by other agencies and used by the DOE (see Section 4.8.3.2 and Chapter 7), and 4) the nature of SNL/NM activities near cultural resources. Implementation of the regulations and procedures would make unlikely any adverse impacts resulting from construction, demolition, decontamination, renovation, or ER Project activities.

Under the Reduced Operations Alternative, prehistoric and historic cultural resources could potentially be affected by activities performed at five SNL/NM facilities, although the potential for impact would be low to negligible. These facilities consist of the Aerial Cable Facility, Lurance Canyon Burn Site, Thunder Range, Sled Track Complex, and Terminal Ballistics Complex. The first three facilities are located on land not owned by the DOE. Impacts could potentially result from three activities at these facilities: production of explosive testing debris and shrapnel, off-road vehicle traffic, and unintended fires and fire suppression. A decrease in the frequency of these activities under the Reduced Operations Alternative would result in a lower potential for impacts than the No Action Alternative.

Another source of potential impact derives from the restricted access present at KAFB and at individual SNL/NM facilities. Restricted access to areas within the ROI would have positive effects on cultural resources themselves. Under the Reduced Operations Alternative, current security levels that restrict access would be maintained for KAFB in general, but would diminish in frequency for specific SNL/NM facilities during various activities due to the reduced frequency of these activities. This would result in a decreased frequency of added protection at SNL/NM facilities for cultural resources.

5.5.7 Air Quality

The implementation of the Reduced Operations Alternative would result in air quality impacts that would be less than or equal to those estimated for the No Action Alternative (see Section 5.3.7). Section 5.5.7.1 describes nonradiological air quality impacts under the Reduced Operations Alternative, and Section 5.5.7.2 describes radiological impacts.

5.5.7.1 Nonradiological Air Quality

The Reduced Operations Alternative reflects minimum levels of activity required to maintain a facility's assigned capability. In some facilities, this alternative includes activity levels that would represent an increase over the base period activity levels (typically 1991 through 1995). In these cases, the activity levels would be those that, during the baseline period, have not been exercised sufficiently to maintain capability or to satisfy assigned theoretical or experimental research and development product requirements of the DOE.

Criteria Pollutants

The criteria pollutants generated under the Reduced Operations Alternative would be less than or equal to those described for the No Action Alternative. The sources of criteria pollutants would include the steam plant, electric power generator plant, boiler and emergency generator in Building 701, and the 600-kw-capacity generator in Building 870b. The criteria pollutant sources represent SNL/NM infrastructure and are not influenced by mission-specific activity levels. These sources would operate at levels comparable to those projected for the No Action Alternative. Table 5.3.7–1 presents the No Action Alternative criteria pollutant concentrations. Although this alternative reflects the minimum activity levels required to maintain a facility's assigned capability, the requirement for heat and emergency electric power would be likely to remain at the No Action Alternative level.

Mobile Sources

Motor vehicle emissions under the Reduced Operations Alternative would include carbon monoxide emissions from decreased commuter traffic. The estimated commuter traffic would be 97 percent of that under the No Action Alternative, or 13,175 commuter vehicles and 582 on-base vehicles. The carbon monoxide emission factor is determined by the EPA mobile source emission factor model *MOBILE5a*, projected to 2005, or 28.5 g per mi (SNL 1996c). Projected carbon monoxide emissions for SNL/NM under the Reduced Operations Alternative, based on the aforementioned assumptions and modeled emission factor, would be 3,385 tons per year, which is 702 tons per year less than the 1996 baseline. Projected carbon monoxide emissions for Bernalillo county for 2005 would be 206 tons per day, or 75,190 tons per year (AEHD 1998). The contribution of carbon monoxide emissions from vehicles commuting to and from SNL/NM and SNL/NM-operated on-base vehicles in 2005 would be 4.5 percent of the total county highway mobile sources carbon monoxide emissions. These estimates represent the Reduced Operations Alternative contribution of carbon monoxide emissions from mobile sources from SNL/NM.

Total carbon monoxide emissions will, therefore, also be less than those presumed for the No Action Alternative; and similarly, the DOE has concluded that no conformity determination is required for the Reduced Operations Alternative.

Lurance Canyon Burn Site

Lurance Canyon Burn Site emissions criteria and chemical pollutants are bounded by the No Action Alternative emissions. Operations at the Lurance Canyon Burn Site would be at or below the level of operations presented for the No Action Alternative. Table 5.3.7–4 presents the criteria pollutant concentrations estimated at the KAFB site boundary for the No Action Alternative level of activity, representing a test using 1,000 gal of JP-8 fuel. For each of the criteria pollutants (carbon monoxide, nitrogen dioxide, PM_{10}, and sulfur dioxide), for each of the averaging times, the modeled concentrations would be less than 5 percent of the applicable national and New Mexico ambient air quality standards. None of the chemical pollutants from tests performed at the facility would result in modeled concentrations above the OEL/100 guideline used to screen the chemical emissions for further analysis. Tests conducted at the Lurance Canyon Burn Site under the Reduced Operations Alternative would result in criteria and chemical pollutant concentrations less than or equal to those under the No Action Alternative.

Chemical Pollutants (Noncarcinogenic and Carcinogenic)

The estimated chemical usage under the Reduced Operations Alternative would be less than that under the No Action Alternative, resulting in concentrations less than or equal to those presented in Table 5.3.7–6. The usage of chemicals is based on mission activity levels, which for the Reduced Operations Alternative would be less than those under the No Action Alternative level of activity. The estimates of chemical usage for the Reduced Operations Alternative for 5 of the 12 major chemical users range from a factor of 1.0 to 0.2 times the chemical usage for the base year 1996, and less than under the No Action Alternative usage for each facility.

5.5.7.2 Radiological Air Quality

The SWEIS analysis reviewed the radiological emissions from all SNL/NM facilities. Section 4.9.2 identifies 17 SNL/NM facilities as producing radiological emissions. Based on historic SNL/NM radionuclide emissions data, NESHAP compliance reports, and the FSID (SNL/NM 1998ee), 10 of the 17 SNL/NM facilities were modeled for radiological impacts (Table 5.5.7–1). The ACRR would be operated under one of two configurations: medical isotope production (primarily molybdenum-99 production) or DP. However, for the purpose of conservative analysis, the ACRR was evaluated under simultaneous operation of both configurations. For analysis purposes, based on the review of historical dose evaluations, other facilities that would not contribute more than 0.01 mrem/yr (0.1 percent of the NESHAP limit) to the MEI were screened from further consideration in the SWEIS. The modeled releases to the environment would result in a calculated dose to the MEI and the population within 50 mi of TA-V. TA-V was selected as a center for the population within a 50-mi radius, because the majority of radiological emissions would be from TA-V, specifically the HCF, and TA-V is historically addressed for annual SNL/NM NESHAP compliance.

The *CAP88-PC* computer model (DOE 1997e) was used to calculate the doses. Details on the *CAP88-PC* model, radionuclide emissions, model and source parameters, exposures, meteorological data, and population data are presented in Appendix D. Figure 5.3.7–3 shows the locations of the 10 facilities modeled in the SWEIS. Table 5.5.7–1 presents the estimated radiological emissions from the 10 SNL/NM facilities under the Reduced Operations Alternative. The radiological emissions from each facility were estimated based on SNL/NM planned operations and tests projected into the future. Detailed information is available in the FSID (SNL/NM 1998ee). The emission of argon-41 from the ACRR, under the medical isotope production configuration, would be lower than during the base year, 1996, because of the refurbishing operations conducted during 1996. The SPR emissions were estimated to be higher than emissions during the base year. This is due to instituting NESHAP requirements for "confirmatory measurements" of radiological air emissions where measured emission factors were determined for both the SPR and the ACRR. These measured emission factors were found to be higher than the calculated emission factors. These measurements are source-specific to the SPR and ACRR and would not affect the calculations or measurements for other facilities.

Because the general public and USAF personnel have access to SNL/NM, 14 core receptor locations and 2 offsite receptor locations of public concern were considered for dose impact evaluations (see Appendix D.2). Based on NESHAP reports, 16 onsite and 6 offsite additional receptor locations were also evaluated. A total of 38 receptor locations were evaluated for dose impacts. The core receptor locations include schools, hospitals, a museum, and clubs, and were considered for analysis because of potential impacts to children, the sick, and the elderly. The 32 modeled onsite and core receptor locations are shown in Figure 5.3.7–4.

The dose to an individual at each receptor and to the population within 50 mi from the radionuclide emissions from each source was calculated using the *CAP88-PC* model. The receptor receiving the maximum dose was identified as the MEI. The model-calculated dose contributions, including external, inhalation, and ingestion from each of the 10 sources, calculated individually at each receptor location, were combined to determine the overall SNL/NM site-wide normal operations dose to the MEI. Under the Reduced Operations Alternative, the maximum EDE to the MEI from all exposure pathways from all modeled sources was calculated to be 0.020 mrem per year. This MEI having the highest combined dose would be located at the Eubank gate area, offsite of SNL/NM. The EDE contributions from these 10 sources to this combined MEI dose are presented in Table 5.5.7–2. Table 5.5.7–3 presents the doses to 38 onsite, core, and offsite receptor locations. The potential doses for these additional locations would be much lower than the highest

Table 5.5.7–1. Radiological Emissions from Sources at SNL/NM Under the Reduced Operations Alternative

FACILITY NAME	TECHNICAL AREA	RADIONUCLIDE[a]	RELEASE (Ci/year)
Annular Core Research Reactor (ACRR, medical isotopes production configuration), Building 6588	V	Argon-41 Tritium	0.24 0.24
Explosive Components Facility (ECF), Building 905	II	Tritium	2.0×10^{-3}
High-Energy Radiation Megavolt Electron Source (HERMES III), Building 970	IV	Nitrogen-13 Oxygen-15	1.0×10^{-4} 1.0×10^{-5}
Hot Cell Facility (HCF), Building 6580	V	Iodine-131 Iodine-132 Iodine-133 Iodine-134 Iodine-135 Krypton-83m Krypton-85 Krypton-85m Krypton-87 Krypton-88 Xenon-131m Xenon-133 Xenon-133m Xenon-135 Xenon-135m	0.117 0.3 0.54 0.022 0.33 19.8 0.019 29.0 5.7 48.0 0.18 216.0 10.2 207.0 36.0
Mixed Waste Landfill (MWL)	III	Tritium	0.29
Neutron Generator Facility (NGF), Building 870	I	Tritium	156
Radioactive and Mixed Waste Management Facility (RMWMF), Building 6920	III	Tritium	2.203[b]
Radiographic Integrated Test Stand (RITS), Building 970	IV	Nitrogen-13	0.02
Sandia Pulsed Reactor (SPR), Building 6590	V	Argon-41	2.85

Source: SNL/NM 1998a
Ci/year: Curies per year
DP: Defense Programs
SNL/CA: Sandia National Laboratories/California

[a] Radiological emissions are projections based on planned activities, projects, and programs. Radionuclide releases are not the same as those presented in Chapter 4.
[b] Because SNL/CA tritium-contaminated oil levels handled at RMWMF during the base year were abnormally high, this maximum level of emissions was assumed to be released in any year and, therefore, was constant for all alternatives.

Table 5.5.7–2. Summary of Dose Estimates to SNL/NM Public Under the Reduced Operations Alternative from Radioactive Air Emissions

SOURCE	ANNUAL MEI DOSE, EDE (mrem)	ANNUAL POPULATION DOSE, person-rem
Annular Core Research Reactor (ACRR, medical isotopes production configuration)	7.1×10^{-6}	1.2×10^{-3}
Explosive Components Facility (ECF)	1.9×10^{-8}	4.19×10^{-7}
High-Energy Radiation Megavolt Electron Source (HERMES III)	2.2×10^{-9}	1.7×10^{-8}
Hot Cell Facility (HCF)	2.8×10^{-3}	0.461
Mixed Waste Landfill (MWL)	4.9×10^{-6}	6.16×10^{-4}
Neutron Generator Facility (NGF)	1.7×10^{-2}	0.322
Radioactive and Mixed Waste Management Facility (RMWMF)	1.9×10^{-5}	3.24×10^{-3}
Radiographic Integrated Test Stand (RITS)	4.5×10^{-7}	3.4×10^{-6}
Sandia Pulsed Reactor (SPR)	3.1×10^{-5}	7.6×10^{-3}
TOTAL MEI DOSE	**2.0×10^{-2}**	-
50-MILE POPULATION COLLECTIVE DOSE	-	**0.80**

Sources: DOE 1997e, SNL/NM 1998a
DP: Defense Programs
EDE: effective dose equivalent
MEI: maximally exposed individual
mrem: millirem

Note: Although the Annular Core Research Reactor is expected to be operated under DP configuration intermittently, for this analysis, it was assumed to be operated continuously in conjunction with molybdenum-99 production. Its contribution to the total dose would not be appreciable.

Table 5.5.7–3. Summary of Dose Estimates From Radioactive Air Emissions to 38 Onsite and Offsite Receptors Under the Reduced Operations Alternative

RECEPTOR	ANNUAL RECEPTOR DOSE, EDE (mrem)
ONSITE AND NEAR-SITE RECEPTORS	
Albuquerque International Sunport (Bldg. 1064)	3.6×10^{-3}
Albuquerque International Sunport (Bldg. 760)	5.4×10^{-3}
Building 20706	7.8×10^{-3}
Building 24499	7.5×10^{-3}
Child Development Center-East	5.1×10^{-3}
Child Development Center-West	2.6×10^{-3}
Civil Engineering Research Facility (Bldg. 5701)	1.4×10^{-3}
Coronado Club	5.7×10^{-3}
Coyote Canyon Control Center	1.4×10^{-3}
Golf Course Clubhouse	7.9×10^{-3}
Golf Course Maintenance Area	5.5×10^{-3}
Kirtland Elementary School	2.5×10^{-3}
KAFB Firestation #4 (Bldg. 9002)	1.9×10^{-3}
KAFB Landfill	5.0×10^{-3}
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)	1.6×10^{-2}
Loop Housing	8.4×10^{-3}
Lovelace Hospital	2.8×10^{-3}
Lovelace Respiratory Research Institute	1.4×10^{-3}
Manzano Offices (Fire Station)	3.8×10^{-3}
Maxwell Housing	2.2×10^{-3}
National Atomic Museum	9.0×10^{-3}
Pershing Park Housing	4.9×10^{-3}
Riding Stables	6.8×10^{-3}
Sandia Base Elementary	4.1×10^{-3}
Sandia Federal Credit Union	1.4×10^{-2}
Shandiin Day Care Center	6.3×10^{-3}
Technical Onsite Inspection Facility	6.8×10^{-3}
Veterans Affairs Medical Center	4.0×10^{-3}
Wherry Elementary School	4.5×10^{-3}

Table 5.5.7–3. Summary of Dose Estimates From Radioactive Air Emissions to 38 Onsite and Offsite Receptors Under the Reduced Operations Alternative (concluded)

RECEPTOR	ANNUAL RECEPTOR DOSE, EDE (mrem)
Zia Park Housing	$5.8x10^{-3}$
OFFSITE RECEPTORS	
Albuquerque City Offices	$1.5x10^{-2}$
East Resident	$1.1x10^{-2}$
Eubank Gate Area (Bldg. 8895)	$2.0x10^{-2}$
Four Hills Subdivision	$1.0x10^{-2}$
Isleta Gaming Palace	$1.1x10^{-2}$
Northeast Resident	$1.2x10^{-2}$
Seismic Center (USGS)	$1.1x10^{-2}$
Tijeras Arroyo (West)	$1.5x10^{-2}$

Sources: DOE 1997e, SNL/NM 1998a
EDE: effective dose equivalent
mrem: millirem
USGS: U.S. Geological Survey

combined MEI dose. Under the Reduced Operations Alternative, the total collective dose to the population of 732,523 within a 50-mi radius of TA-V was calculated to be 0.80 person-rem per year. The contributions from all of the 10 modeled sources to the overall SNL/NM site-wide normal operations collective dose to the population within 50 mi are also presented in Table 5.5.7–2. The average dose to an individual in the population within 50 mi of TA-V (collective dose divided by the total population) would be $1.1x10^{-3}$ mrem per year.

The calculated total MEI dose of 0.020 mrem per year (see Table 5.5.7–2) would be much lower than the regulatory limit of 10 mrem per year to an MEI from SNL/NM site-wide total airborne releases of radiological materials (40 CFR Part 61). This dose would be small compared to an individual background radiation dose of 360 mrem per year (see Figure 4.10–2). The calculated collective dose from SNL/NM operations to the population within 50 mi of TA-V would be 0.80 person-rem per year, which would be much lower than the collective dose from background radiation. Based on this individual radiation dose, the population within 50 mi of TA-V would receive 263,700 person-rem per year.

5.5.8 Human Health and Worker Safety

The implementation of the Reduced Operations Alternative would result in human health and worker safety impacts for normal and accident conditions, as detailed in the following sections.

5.5.8.1 Normal Operations

This section provides information on public health and worker health and safety under the Reduced Operations Alternative. It assesses the potential human health effects associated with routine releases of radioactive and nonradioactive hazardous material from normal SNL/NM operations. For detailed discussions of analytical methods and results along with terminology, definitions, and descriptions, see Appendix E.

Health risk analyses are presented for potential exposures at specific receptor locations and for the potential maximum exposures to radiation and chemical air releases. For a description of receptor locations, exposure scenarios, and environmental pathways selected for assessing human health impacts, see Section 5.3.8.

Chemical Air Release Pathways

Under the Reduced Operations Alternative, chemical use would be less than the quantities anticipated under the No Action Alternative. Therefore, the exposure to receptors would also decrease. Potential exposure concentrations of chemicals under the Reduced Operations Alternative are estimated and shown in Appendix E, Table E.3–4. The chemical assessment process, described in Section 5.3.8 for chemical air release pathways, identified seven COCs under the Reduced Operations Alternative. Several of the COCs are common among the three facilities. These COCs are associated with SNL/NM operations in Buildings 878 (AMPL), 897 (IMRL), and 870 (NGF).

The health risk and corresponding potential for adverse health effects from airborne exposures to chemicals is a range of values. Several receptor locations, individual exposure scenarios, and a hypothetical worst-case exposure scenario were used to represent this range. Adult, child, residential, and visitor risk assessments were calculated. Table 5.5.8–1 lists the human health impacts from the estimated exposures to chemical air releases from SNL/NM facility operations. These potential health risks would be low and no adverse health effects would occur at these risk levels. Assessing the hypothetical worst-case exposure scenario for chemicals establishes the upper limit (bounding value) to health risk. Under the Reduced Operations Alternative, the upper bound value for health risk from noncarcinogenic chemicals would be HIs of less than 1; from carcinogenic chemicals, the ELCRs would be less than 10^{-6} (see Table E.6–5).

Radiation Air Release Pathways

Under the Reduced Operations Alternative, air releases of radionuclides would be lower than those projected under the No Action Alternative. Section 5.5.7 identifies these lower doses to the MEI and the population within the ROI. Radiological health effects would also be lower under the Reduced Operations Alternative. The greatest dose resulting from the SNL/NM yearly air release of radionuclides would occur offsite at the Eubank gate and would increase the lifetime risk of fatal cancer to the MEI by $1.0x10^{-8}$. This means that the likelihood of fatal cancer to the MEI from a 1-year dose from SNL/NM normal operations would be less than 1 chance in 100 M. The annual collective dose to the population due to these releases would increase the annual number of fatal cancers in the entire population within the ROI by $4.0x10^{-4}$. Therefore, no additional LCFs would be likely to occur in the ROI due to SNL/NM radiological air releases.

To estimate a range in the potential for human health effects, radiation doses at specific receptor locations such as schools, hospitals, and daycare centers in the SNL/NM vicinity were calculated. These doses are identified in Table 5.5.7–3. Radiological health risks associated with the doses to receptors at several of these locations are presented in Table 5.5.8–2. The risk from radiation at these receptor locations would be much lower than the highest risk determined for the MEI receptor offsite at the Eubank gate.

Receptors in the SNL/NM vicinity would also have the potential to be exposed to radionuclides by way of the indirect air pathway of ingesting food that contains radionuclides. *CAP88-PC* integrates doses from this pathway in the collective dose estimation for the population within the ROI, but does not integrate it to the dose evaluation for the potential onsite MEI receptor. The estimated percentage of the population dose from ingesting potentially contaminated food would be 18 percent (0.101 person-rem of the 0.80 person-rem collective population dose) which means it would also account for approximately 13 percent of the health risk value. When the same percent contribution is assumed, the potential onsite MEI's lifetime risk of fatal cancer from a 1-year dose would be increased by $1.0x10^{-9}$ (18 percent) under the Reduced Operations Alternative. Overall, the cancer risk to the MEI from radiation would remain less than 1 chance in 100 M.

Nonfatal Cancers and Genetic Disorders

Radiation exposures can cause nonfatal cancers and genetic disorders. The NCRP has adopted risk estimators developed by the ICRP for the public assessing these health effects from radiation (ICRP 1991). Under the Reduced Operations Alternative, SNL/NM's maximum annual dose to the MEI would increase the lifetime risk of nonfatal cancers and genetic disorders by $1.6x10^{-9}$ and $2.1x10^{-9}$, respectively, which would be less than 1 chance in 475 M. The SNL/NM annual collective dose to the ROI population would increase the number of nonfatal cancers and genetic disorders by $8.0x10^{-5}$ and $1.0x10^{-4}$, respectively. This means that no additional nonfatal cancers or genetic disorders would be likely to occur in the ROI population from SNL/NM radiological air releases.

Transportation

The potential human health risks and accident fatalities for transporting various radiological materials for SNL/NM operations are discussed in Section 5.5.9. The radiological dose to the population along the route within the ROI was estimated by assuming 10 percent of the total travel distance would occur within the ROI. Therefore, 10 percent of the total radiological dose (off link and on link) calculated for all radiological materials transport would be considered as an additional human health impact to the population along the route within the ROI (see Appendix G). This percentage of the annual collective dose to the population along the route due to transportation activities would increase the ROI number of LCFs by $2.0x10^{-4}$. Adding this to the number of LCFs associated

Table 5.5.8–1. Human Health Impacts in the Vicinity of SNL/NM from Chemical Air Emissions Under the Reduced Operations Alternative

RECEPTOR LOCATIONS	RECEPTOR	TOTAL HAZARD INDEX RME/AEI	TOTAL EXCESS LIFETIME CANCER RISK RME/AEI
RESIDENTIAL SCENARIOS			
Four Hills Subdivision[a]	Adult	<0.01/<0.01	$1.8x10^{-11}/1.1x10^{-11}$
	Child	<0.01/<0.01	$7.4x10^{-12}/7.4x10^{-12}$
Isleta Gaming Palace	Adult	<0.01/<0.01	$1.7x10^{-10}/1.7x10^{-12}$
	Child	<0.01/<0.01	$1.2x10^{-10}/1.3x10^{-12}$
KAFB Housing (Zia Park Housing)	Adult	<0.01/<0.01	$3.6x10^{-10}/3.8x10^{-12}$
	Child	<0.01/<0.01	$2.5x10^{-10}/2.9x10^{-12}$
VISITOR SCENARIOS			
Child Development Center-East	Child	<0.01/<0.01	$3.4x10^{-10}/3.9x10^{-12}$
Child Development Center-West	Child	<0.01/<0.01	$6.7x10^{-11}/7.6x10^{-13}$
Coronado Club	Adult	<0.01/<0.01	$5.9x10^{-10}/6.0x10^{-12}$
	Child	<0.01/<0.01	$4.1x10^{-10}/4.6x10^{-12}$
Golf Course (Clubhouse)	Adult	<0.01/<0.01	$1.9x10^{-11}/1.9x10^{-12}$
Kirtland Elementary School	Child	<0.01/<0.01	$5.5x10^{-11}/6.2x10^{-13}$
Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC)[b]	Adult	<0.01/<0.01	$1.8X10^{-10}/1.8x10^{-12}$
Lovelace Hospital	Adult	<0.01/<0.01	$1.6x10^{-10}/1.7x10^{-12}$
	Child	<0.01/<0.01	$1.1x10^{-10}/1.3x10^{-12}$
National Atomic Museum	Adult	<0.01/<0.01	$9.9x10^{-10}/1.0x10^{-11}$
	Child	<0.01/<0.01	$6.9x10^{-10}/7.8x10^{-12}$
Riding Stables	Adult	<0.01/<0.01	$9.7x10^{-11}/1.0x10^{-12}$
Sandia Base Elementary School	Child	<0.01/<0.01	$4.7x10^{-10}/5.3x10^{-12}$
Shandiin Day Care Center	Child	<0.01/<0.01	$3.7x10^{-10}/4.2x10^{-12}$
Veterans Affairs Medical Center	Adult	<0.01/<0.01	$1.6x10^{-10}/1.6x10^{-12}$
Wherry Elementary School	Child	<0.01/<0.01	$2.5x10^{-10}/2.8x10^{-12}$

Source: SmartRISK 1996
AEI: average exposed individual
RME: reasonable maximum exposed
[a] Four Hills Subdivision receptor location impacts were based on Lurance Canyon Burn Site open burning air emissions, not SNL/NM building air emissions.
[b] This receptor location was analyzed using a worker scenario, as discussed in Appendix E.5.
Note: See Section 5.3.8 for a discussion of selection of receptor locations.

Table 5.5.8–2. Human Health Impacts in the SNL/NM Vicinity from Radiological Air Emissions Under the Reduced Operations Alternative

RECEPTOR LOCATIONS	LIFETIME RISK OF FATAL CANCER FROM A 1-YEAR DOSE
Child Development Center-East	2.6×10^{-9}
Child Development Center-West	1.3×10^{-9}
Coronado Club	2.9×10^{-9}
Four Hills Subdivision	5.0×10^{-9}
Golf Course (Clubhouse)	4.0×10^{-9}
Kirtland Elementary School	1.3×10^{-9}
KAFB Housing (Zia Park Housing)	2.9×10^{-9}
Kirtland Underground Munitions & Maintenance Storage Complex (KUMMSC)[a]	8.0×10^{-9}
Lovelace Hospital	1.4×10^{-9}
National Atomic Museum	4.5×10^{-9}
Riding Stables	3.4×10^{-9}
Sandia Base Elementary School	2.1×10^{-9}
Shandiin Day Care Center	3.2×10^{-9}
Isleta Gaming Palace	5.5×10^{-9}
Veterans Affairs Medical Center	2.0×10^{-9}
Wherry Elementary School	2.3×10^{-9}

Sources: DOE 1997e, SNL/NM 1998a
MEI: maximally exposed individual
[a] The radiological MEI location for normal operations.
Note: Calculations were completed using *CAP88-PC*.

with the annual collective population dose from routine air releases would change the risk to 6.0×10^{-4}. In other words, no additional LCFs in the ROI population would likely occur from SNL/NM radiological material transportation activities.

Composite Cancer Risk

The increase in lifetime cancer risk due to SNL/NM normal operations is associated with both the small amounts of radionuclides and small amounts of carcinogenic chemicals emitted into the air. The composite cancer risk associated with the Reduced Operations Alternative would be lower than that calculated for either the No Action or Expanded Operations Alternatives. Under those alternatives, the composite cancer risk values calculated would all be within the EPA risk range established for the protection of human health of 10^{-6} to 10^{-4} (40 CFR Part 300). This would be a risk of less than 1 chance in 1 M. The SNL/NM potential contribution to an individual's lifetime cancer risk is very low considering that in the U.S., men have a 1-in-2 lifetime risk and women have a 1-in-3 lifetime risk of developing cancer. One out of every four deaths in the U.S. is from cancer (ACS 1997).

Worker Health and Safety

Under the Reduced Operations Alternative, the worker safety assessment shows impacts would be less than those under the No Action Alternative. Worker health consequences would be the same as those presented in Section 4.10 for the period 1992 through 1996. Tables and figures in Section 4.10 show that for the entire SNL/NM worker population, zero fatalities per year, an average of 47 mrem per year radiation dose (TEDE) to radiation-badged workers, approximately 287 nonfatal injuries and illnesses per year, and 1 or 2 confirmed chemical exposures occurred annually from 1992 through 1996.

Routine air emissions evaluated for potential exposures to specific receptors in the SNL/NM vicinity have the potential to impact noninvolved workers at SNL/NM. A noninvolved worker is not exposed to chemical or radiological work related activities but is potentially exposed because they work at SNL/NM in the vicinity of facility releases. Potential exposures to airborne radiation were identified using the KUMMSC receptor location. Potential exposures to airborne chemicals were identified using a receptor location at the center of TA-I, near SNL/NM's chemical facility sources. Based on an exposure scenario for a worker, health risks from chemicals to the noninvolved worker would be below a HI of 1 and less than 10^{-6} for an ELCR (see Appendix E, Table E.6–5).

The average annual individual worker dose, annual maximum worker dose, and annual workforce collective dose for the radiation workers under the Reduced Operations Alternative are identified in Table 5.5.8–3. Health risks from the annual average individual and annual maximum worker doses would be expected to remain constant for all alternatives (based on the REMS database dose information for 1996). The annual collective dose to the radiation worker population at SNL/NM would be lower than under the No Action Alternative. This would equate to a lower risk of fatal cancer to the radiation worker population under the Reduced Operations Alternative.

Table 5.5.8–3. Radiation Doses (TEDE)[a] and Health Impacts to Workers from SNL/NM Operations Under the Reduced Operations Alternative

RADIATION WORKER DOSE RATES	RADIATION DOSE	RISK OF CANCER FATALITY FROM A 1-YEAR DOSE
Annual Average Individual Worker Dose	47[b] (mrem/yr)	1.9×10^{-5}
Annual Maximum Worker Dose	845[b] (mrem/yr)	3.4×10^{-4}
RADIATION WORKER DOSE RATES	**RADIATION DOSE**	**NUMBER OF LCFs**
Annual Workforce Collective Dose	10 (person-rem/year)	4.0×10^{-3}

Source: SNL/NM 1997k
mrem/yr: millirems per year
TEDE: total effective dose equivalent
[a] Average measured TEDE means the collective TEDE divided by the number of individuals with a measured dose greater than 10 mrem.
[b] Annual average individual and annual maximum worker doses would be expected to remain consistent with the base year, 1996 (see Section 4.10).
Note: Because not all badged workers are radiation workers, "radiation workers" means those badges with greater than 10 mrem above background measurements used in the calculations.

Nonfatal Cancers and Genetic Disorders

The SNL/NM maximum annual dose to the radiation worker population would increase the number of nonfatal cancers and genetic disorders by 8.0×10^{-4}, based on the ICRP dose-to-risk conversion factor for workers of 80 health effects per 1 M person-rem for both effects. In other words, no additional nonfatal cancers or genetic disorders would be likely to occur in the SNL/NM radiation worker population due to operations. The annual average and annual maximum workers dose and associated potential health impacts would remain consistent with 1996 values.

Nonionizing Radiation

Routine high-voltage impacts to SNL/NM and the public would not occur.

5.5.8.2 Accidents

This section describes, under the Reduced Operations Alternative, the potential impacts to workers and the public for accidents involving the release of radioactive and/or chemical materials, explosions, and other hazards. Additional details on the accident analyses and impacts are presented in Appendix F.

Site-Wide Earthquake

An earthquake in the Albuquerque, New Mexico, area has the potential for human injury and building damage throughout the local region. Due to differences in structural design, SNL/NM buildings and structures vary in their capabilities to withstand earthquake forces. Any magnitude earthquake has the potential to cause injury to workers in and around buildings and damage to structures from the physical forces and effects of the earthquake. Additional injury to workers and the public would be possible from explosions and from exposure to chemical and radioactive materials that could be released from buildings and storage containers. Facilities in TA-I are the predominant source of chemical materials that could be released during an earthquake. Facilities in TA-V are the predominant source of radioactive materials that could be released. The ECF in TA-II is the predominant source of explosive materials. Lesser quantities of radioactive materials in TAs-I and -II could also be released and cause exposures to workers and the public.

The UBC specifies different levels of seismic design depending on the location and proposed use of a facility or structure. For office buildings and other nonhazardous use of buildings, the UBC specifies an acceleration of 0.17 *g* for the Albuquerque area. This level seismic design would apply to most buildings in TA-I. For those facilities that would contain radioactive materials, the UBC specifies an acceleration level of 0.22. In the event of an earthquake (UBC, 0.17 *g*), various buildings in TA-I could be affected and various chemicals could be released (see Appendix F, Table F.7–7). Larger magnitude earthquakes could cause more serious impacts. The only dominant chemical that changes among the alternatives is arsine, and it is not released in the earthquake at 0.17 *g* and lesser accelerations. Therefore, failure of facilities at lesser accelerations would not affect the differences in risk among the alternatives, and the spectrum of accidents would essentially be unchanged. The shape and direction of the chemical plumes would depend upon local meteorological conditions and physical structures. The plumes shown on Figure 5.5.8–1 are positioned to reflect the predominant wind direction during daylight hours. The daylight period was chosen to maximize the number of people potentially affected onsite, because more people are working onsite during the daytime than during nighttime periods. The circled area represents the potential area that could be affected by other wind directions. For wind blowing toward the north-northeast, there would be up to 423 people exposed to chemical concentrations above ERPG-2. Existing and known mitigation features designed to limit the release of chemicals from storage containers, rooms, and buildings would limit or reduce plume size, concentration levels, and exposures. Emergency procedures and sheltering would also minimize exposures to workers and the public.

Nuclear facilities in TAs-I, -II, and -V could also be damaged during an earthquake. The frequency of an earthquake (0.17 *g*) that could cause the release of radioactive materials from TAs-I and -II facilities is 1.0×10^{-3} per year, or 1 chance in 1,000 per year. The frequency of an earthquake (0.22 *g*) that could cause the release of radioactive materials from TAs-I (NG-1), -II (ECF-1), and -V facilities is 7.0×10^{-4} per year, or 1 chance in 1,500 per year. The consequences are shown in Table 5.5.8–4. If a 0.22-*g* earthquake was to occur, there would be an estimated 6.4×10^{-2} additional LCFs in the total population within 50 mi of the site, associated with the HC-1 accident scenario. The MEI and noninvolved worker would have an increased probability of LCF of 6.9×10^{-6} and 3.0×10^{-2}, respectively, associated with the HC-1 accident scenario. The risks for these receptors can be estimated by multiplying these consequence values by the probability (frequency) of earthquake. If a stronger earthquake was to occur, larger releases of radioactive materials would be possible and could cause greater impacts.

A severe earthquake could also cause damage to other SNL/NM facilities and result in environmental impacts. For example, the large quantities of oil stored in external tanks and in accelerator buildings in TA-IV could potentially be spilled and cause impacts to the ecosystem and water resources. Underground natural gas lines could break and ignite causing brush and forest fires that could further damage facilities and persons in the vicinity. Hydrogen storage tanks in TA-I could be damaged, causing hydrogen combustion or explosion and potential injury to persons in the vicinity. Explosives in the ECF in TA-II and smaller quantities in other facilities could also be accidentally detonated during an earthquake with potential injury to persons in the vicinity. Occupants of all facilities would be at risk of injury as a result of the earthquake forces and building damage.

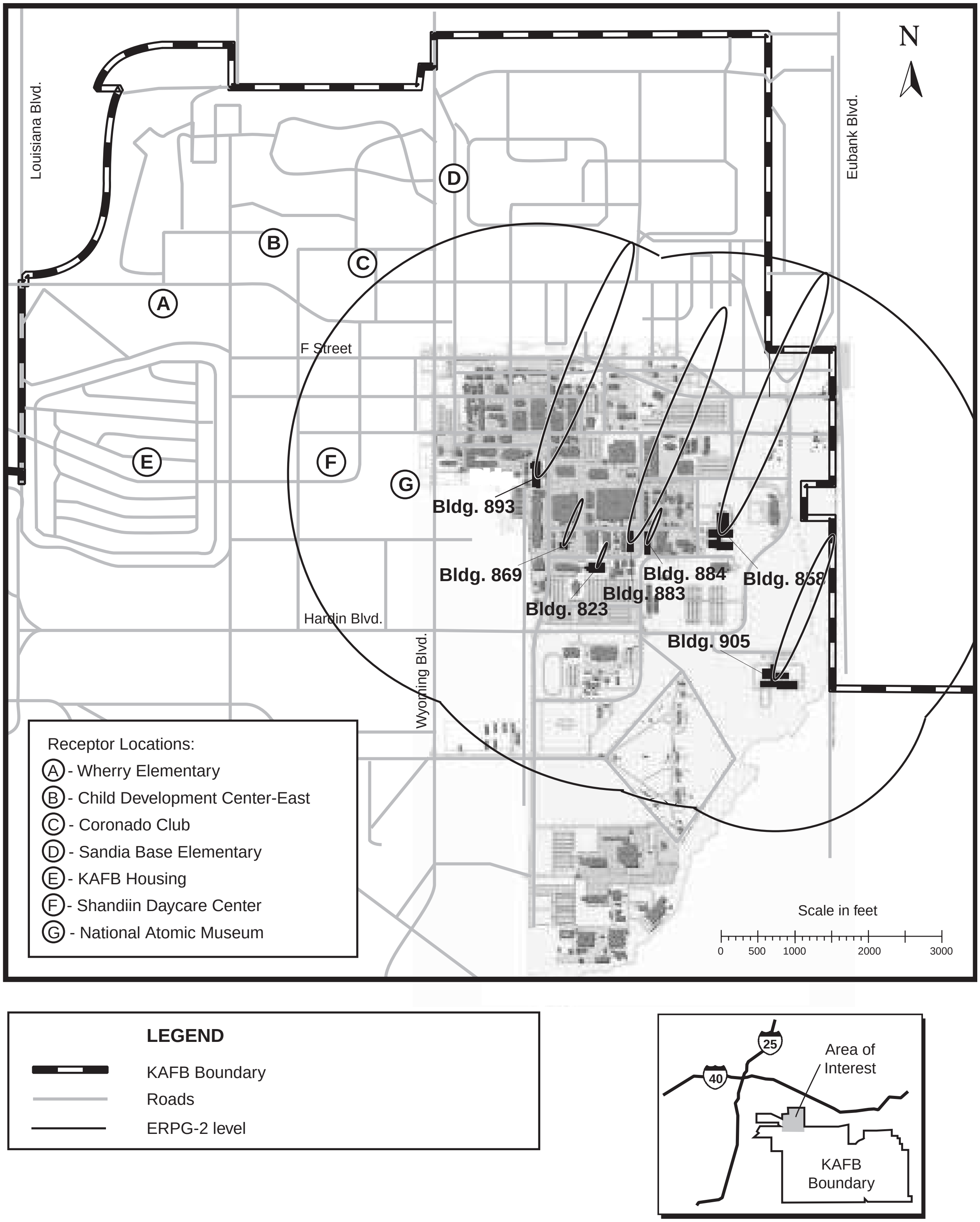
Facility Hazards

Some of the facilities at SNL/NM could contain occupational hazards with the potential to endanger the health and safety of involved workers near an accident. Some of these facilities also contain hazardous materials that, in case of an accident, could endanger the health and safety of people within the immediate vicinity and beyond. These people include noninvolved workers, members of the military assigned to KAFB, and a member of the public located within the KAFB boundary and offsite. Offsite consequences were determined to a 50-mi radius around the affected facility.

operational procedures would be implemented to maintain operations within the authorization basis.

Explosion Accidents

Explosive materials are stored, handled, transported, and used at some SNL/NM facilities. Administrative controls and facility design would help prevent an explosion accident and limit the impacts to personnel, if an accident was to occur. The ECF, for example, contains large quantities of explosives for use in its testing programs. Hydrogen trailers are another large source of



Source: Original
Note: see Appendix F.7, Figure F.7–1

Figure 5.5.8–1. Areas Above Emergency Response Planning Guideline 2 from a Site-Wide Earthquake Under the Reduced Operations Alternative

The circled areas represent locations that could be above ERPG-2, depending upon wind direction.

Table 5.5.8–4. Site-Wide Earthquake Radiological Impacts Under the Reduced Operations Alternative

ACCIDENT ID[a]	FREQUENCY (per year)	ADDITIONAL LATENT CANCER FATALITIES WITHIN 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
			MAXIMALLY EXPOSED INDIVIDUAL[b]	NONINVOLVED WORKER[c]
TECHNICAL AREA -I				
NG-1	7.0×10^{-4}	5.1×10^{-5}	1.4×10^{-9}	3.2×10^{-6}
TECHNICAL AREA -II				
ECF-1	7.0×10^{-4}	3.0×10^{-6}	1.5×10^{-10}	1.9×10^{-7}
TECHNICAL AREA -V				
AM-2	7.0×10^{-4}	2.0×10^{-3}	2.4×10^{-7}	7.4×10^{-5}
HC-1	7.0×10^{-4}	6.4×10^{-2}	6.9×10^{-6}	3.0×10^{-2}
SP-1	7.0×10^{-4}	9.2×10^{-3}	5.8×10^{-7}	2.7×10^{-4}

Source: Original (See also Appendix F, Tables F.7–4 and F.7–5)

[a] Facility Accident Descriptors:
Neutron Generator Facility: NG-1
Explosive Component Facility: ECF-1
Annular Core Research Reactor-Medical Isotope Production: AM-2
Hot Cell Facility: HC-1
Sandia Pulsed Reactor: SP-1

[b] The maximally exposed individual would be located at the Golf Course and the consequences can be added.

[c] Because the noninvolved worker is located 100 meters from the release point, the location varies relative to each technical area. Therefore, the consequences to the noninvolved worker can only be added for a given technical area.

Note: The only earthquake radiological accident that changes among alternatives is AR-5, which contributes only 3.9 person-rem to the 150 person-rem population dose. Therefore, failure of facilities at lesser acceleations than 0.22 *g* would not affect the differences in risk among the alternatives, and the spectrum of accidents would essentially be unchanged.

explosive material. There would be approximately five hydrogen trailers parked near facilities or routinely transported to facilities from remote locations.

In the Draft SWEIS, the largest quantity of hydrogen with the highest potential for consequences to both SNL/NM workers and facilities is a set of horizontally mounted cylinders, with a storage capacity of approximately 90,000 SCF, located approximatley east of the CSRL, Building 893, in TA-I. An explosion at the hydrogen storage cylinders near the CSRL was selected for detailed analysis to estimate the bounding impacts of an explosion accident. If a hydrogen explosion were to occur in the relatively populated area of TA-I, individuals in the area could be injured and nearby property could be damaged. Involved workers within 61 ft of an explosion could be seriously injured and would have a 50-percent chance of survival. Involved workers out to a distance of 126 ft from the explosion could receive damage to their eardrums and lungs. The resulting overpressure from this explosion and impacts to personnel and property would diminish with distance.

Based on additional information gathered since the Draft SWEIS was published, the Final SWEIS bounding facility explosion would be in a cryogenic tank with a storage capacity of approximately 493,000 SCF, located northwest of MDL, Building 858, in TA-I. An explosion at the cryogenic tank was selected for detailed analysis to estimate the bounding impacts of an explosion accident.

If a hydrogen explosion were to occur in the relatively populated area of TA-I, individuals in the area could be injured and nearby property could be damaged. Involved workers within 101 ft of an explosion could be seriously injured and would have a 50-percent chance of survivial. Involved workers out to a distance of 210 ft from the explosion could receive damage to their eardrums and lungs. The resulting overpressure from this explosion and impacts to personnel and property would diminish with distance, as shown in Table 5.5.8–5.

The actual number of persons in the vicinity of the accident depends upon many factors and the actual number of potential fatalities is uncertain. Factors include the time of day (start of work day, lunchtime, after hours), the actual location of the people (amount of shielding between the hydrogen tank and the person), and the actual spread of the pressure waves in a very complex arrangement of buildings, alleys, and walkways.

Table 5.5.8–5. Impacts of an Explosion Accident Under the Reduced Operations Alternative

P_r (psi)	PHYSICAL EFFECTS	DISTANCE (ft)	
		472-lb TNT	2203-lb TNT
50	50% survival rate for pressures in excess of 50 psi	61	101
10	50% rate of eardrum rupture and total destruction of buildings for pressures in excess of 10 psi	126	210
2.0	Pressures in excess of 2-3 psi will cause concrete or cinder block walls to shatter.	370	617
1.0	Pressures in excess of 1 psi will cause a house to be demolished.	657	1,096

Source: Original, DOE 1992b (See also Appendix F, Table F.4–1)
ft: feet
lbm: pound mass
psi: pounds per square inch
TNT: trinitrotoluene

This bounding facility explosion was postulated to occur from an accidental uncontrolled release of hydrogen, stored in a tank outside the MDL building, caused by human errors (such as mishandling activities) or equipment failures (such as a pipe joint failure) and the presence of an ignition source (such as a spark) near the location of release. Because multiple failures would have to occur for an uncontrolled release of hydrogen to lead to an explosion, this accident scenario would be extremely unlikely (that is, between $1x10^{-6}$ and $1x10^{-4}$ per year).

The human organs most vulnerable to shock explosions are the ears and lungs because they contain air or other gases. The damage would be done at the gas-tissue interface, where flaking and tearing could occur. Both the ear and the lung responses would be dependent not only on the overpressure, but also on impulse and body orientation. The shorter the pulse width, the higher the pressure the body could tolerate. An overpressure of approximately 50 psi would result in a 50 percent fatality rate; approximately 10 psi would result in eardrum rupture. These overpressure estimates are based on a square pressure wave with a pulse duration greater than 10 msec, and their effects could vary depending on body orientation to the pressure wave.

Structural damage produced by air blasts would depend on the type of structural material. An overpressure on the order of 1 psi would cause partial demolition of houses (rendering them uninhabitable). An overpressure of 2 to 3 psi would shatter unreinforced concrete or cinder block walls shattering; An overpressure of 10 psi would probably cause total destruction of buildings.

Radiological Accidents

The largest quantities of radioactive materials at risk for radiological accidents are located in TA-V. The Manzano Waste Storage Facilities, and TAs-I, -II, and -IV also contain radioactive material, but in smaller amounts. The nuclear facilities in TA-V include the ACRR, SPR, HCF and GIF. The NGIF is under construction in TA-V. The planned primary use of the ACRR is medical isotope production (primarily molybdenum-99). The HCF has been reconfigured for medical isotope production, and the accidents analyzed reflect this mode of operation. Accidents have also been analyzed for storage of radioactive materials in the HCF not associated with molybdenum-99 production.

The most serious radiological accident impacts associated with SNL/NM facilities under the Reduced Operations Alternative are shown in Table 5.5.8–6. The table lists a set of accidents and their consequences in terms of an increased probability of an LCF for an exposed individual and an increased number of LCFs for the offsite population. Other radiological accidents could also occur at these facilities, but their impacts would be within the envelope of the selected set of accidents.

The accident at a single facility with the highest consequences to the public would be a fire in Room 108 at the HCF in TA-V (HS-2). If this accident was to occur, there would be $7.9x10^{-2}$ additional LCFs in the offsite population within 50 mi of the site. There would be an increased probability of an LCF for an MEI and a noninvolved worker of $6.6x10^{-6}$ and $7.4x10^{-6}$, respectively. The estimated frequency of occurrence for this accident would be $2.0x10^{-7}$ per year, or less than 1 chance in 5,000,000 per year. Involved workers run the

Table 5.5.8–6. Potential Impacts of Radiological Facility Accidents Under the Reduced Operations Alternative

FACILITY	ACCIDENT ID[a]	SCENARIO	FREQUENCY PER YEAR	ADDITIONAL LATENT CANCER FATALITIES TO 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
					MAXIMALLY EXPOSED INDIVIDUAL	NONINVOLVED WORKER
Annular Core Research Reactor-medical isotopes production configuration	***AM-1***	Airplane crash - collapse of bridge crane	6.3×10^{-6}	2.0×10^{-3}	2.4×10^{-7}	7.4×10^{-5}
	AM-3	Rupture of waterlogged fuel element	1.0×10^{-2} to 1.0×10^{-4}	4.9×10^{-4}	5.4×10^{-8}	3.8×10^{-6}
	AM-4	Rupture of one molybdenum-99 target	1.0×10^{-4} to 1.0×10^{-6}	3.9×10^{-4}	4.3×10^{-8}	3.0×10^{-6}
	AM-5	Fuel handling accident - irradiated element	1.0×10^{-4} to 1.0×10^{-6}	4.9×10^{-3}	6.1×10^{-7}	7.6×10^{-5}
	AM-6	Airplane crash and fire in reactor room with unirradiated fuel and targets present	6.3×10^{-6}	1.6×10^{-6}	1.0×10^{-10}	4.9×10^{-8}
	AM-7	Target rupture during Annular Core Research Reactor to Hot Cell Facility transfer	$<1.0\times10^{-6}$	3.9×10^{-4}	4.9×10^{-8}	1.4×10^{-5}
Hot Cell Facility-medical isotopes production	***HM-1***	Operator error - molybdenum-99 target processing	1.0×10^{-1} to 1.0×10^{-2}	3.8×10^{-5}	3.3×10^{-9}	1.6×10^{-7}
	HM-2	Operator error - iodine-125 target processing	1.0×10^{-1} to 1.0×10^{-2}	1.6×10^{-6}	1.0×10^{-10}	4.2×10^{-9}
	HM-4	Fire in glovebox	1.0×10^{-2} to 1.0×10^{-4}	2.6×10^{-3}	2.4×10^{-7}	2.3×10^{-6}
Hot Cell Facility-Room 108 Storage	***HS-1***	Fire in room 108, average inventories	3.3×10^{-5}	2.1×10^{-3}	1.8×10^{-7}	2.0×10^{-7}

Table 5.5.8–6. Potential Impacts of Radiological Facility Accidents Under the Reduced Operations Alternative (concluded)

FACILITY	ACCIDENT ID[a]	SCENARIO	FREQUENCY PER YEAR	ADDITIONAL LATENT CANCER FATALITIES TO 50-MILE POPULATION	INCREASED PROBABILITY OF LATENT CANCER FATALITY	
					MAXIMALLY EXPOSED INDIVIDUAL	NONINVOLVED WORKER
Hot Cell Facility-Room 108 Storage (continued)	***HS-2***	Fire in room 108, maximum inventories	$2.0x10^{-7}$	$7.9x10^{-2}$	$6.6x10^{-6}$	$7.4x10^{-6}$
Sandia Pulsed Reactor	***S3M-2***	Control-element misadjustment before insert	$1.0x10^{-4}$ to $1.0x10^{-6}$	$1.2x10^{-3}$	$1.5x10^{-7}$	$2.5x10^{-4}$
	S3M-3	Failure of a fissionable experiment	$1.0x10^{-4}$ to $1.0x10^{-6}$	$7.9x10^{-3}$	$8.4x10^{-7}$	$3.8x10^{-3}$
	SS-1	Airplane crash into North Vault storage vault	$6.3x10^{-6}$	$9.2x10^{-3}$	$5.8x10^{-7}$	$5.5x10^{-4}$

Source: Original
ACRR: Annular Core Research Reactor
SPR: Sandia Pulsed Reactor
TA: technical area
[a] TA-V Facility Accident Descriptors:
ACRR - Medical Isotope Production: AM-1, AM-3, AM-4, AM-5, AM-6, AM-7
Hot Cell - Medical Isotope Production: HM-1, HM-2, HM-4
Hot Cell - Room 108 Storage: HS-1, HS-2
SPR: S3M-2, S3M-3, SS-1

highest risk of injury or fatality in case of many radiological accidents discussed in this section, as well as the many others that could occur. Although there are protective measures and administrative controls to protect involved workers, they are usually in the immediate vicinity of the accidents where they could be exposed to radioactivity. Accident scenarios for the Reduced Operations Alternative are described in Section 5.3.8.2.

The impacts of accidents have also been analyzed for other receptors located on the KAFB site. The impacts to all other receptors would be less than for the MEI. Details on the impacts to the core receptors are provided in Appendix F.2.

Chemical Accidents

Many SNL/NM facilities store and use a variety of hazardous chemicals. For the chemical with the highest RHI in a building, a catastrophic accident and total release of the building inventory was postulated as the bounding event and estimates were made of the chemical's concentrations at various distances from the accident. The results are shown in Table 5.5.8–7. "Building inventory values are shown for the source term release to reflect the variability and uncertainty in the actual amount of the chemical that could be present at the time of an accident. Similarly, estimates are shown for the range of distances within which the ERPG-2 would be exceeded. The ERPG-2 is an accepted guideline for public exposure (see Appendix F.3 for the description of the various ERPG levels).

In the event of a severe chemical accident in TA-I, involved workers, noninvolved workers, KAFB personnel, onsite residents, and onsite and offsite members of the public would be at risk of being exposed to chemical concentrations in excess of ERPG-2 levels. The number of individuals at risk is shown in Table 5.5.8–8. The actual number exposed would depend on the time of day, location of people, wind conditions, and other factors.

As shown in Table 5.5.8–7, the dominant chemical accident would be a catastrophic release of arsine from Building 893 in TA-I. If the building inventory of 65 lb of arsine was released, individuals within a distance of 6,891 ft from the point of release would receive exposures that exceed the ERPG-2. Figure 5.5.8–2 illustrates the KAFB locations that would be affected by chemical accident scenarios involving the release of arsine or chlorine from Buildings 893 and 858, respectively. The plumes on the figure correspond to the areas within which the ERPG-2 would be exceeded. Some individuals within the ERPG-2 plume, close to the release point, could experience or develop irreversible or other serious health effects or symptoms that could impair their abilities to take protective action. For any release, the seriousness of any exposure would generally decrease for distances further from the point of release.

In case of an aircraft crash or earthquake involving buildings with various chemical inventories, multiple chemicals would be released and could mix and interact. Although the impacts of mixed chemicals could be greater than individual chemicals, their behavior, dispersion, and health effects can be complex and have therefore, not been considered quantitatively. An earthquake could also cause the release of like chemicals from multiple buildings and lead to increased concentration where individual plumes overlap. The potential and impacts for overlapping plumes are discussed in Appendix F.3.

Other Accidents

Other types of potential accidents have been identified whose impacts are not measured in terms of LCFs or chemical concentrations. These could cause serious injury or fatality for humans or impacts to the nonhuman environment such as the ecology, historical sites, or sensitive cultural sites.

- *Brush Fires*—Small fires are expected and planned for during outdoor testing that involves propellants and explosives. The potential exists for brush and forest fires when hot test debris or projectiles come in contact with combustible elements in the environment. One such incident was reported in 1993 in TA-III when a rocket motor detonated during a sled track impact test and resulted in a 40-ac brush fire. Another accident occurred at the Aerial Cable Facility in the Coyote Test Field, which resulted in a fire that swept up the side of a mountain before being extinguished by SNL/NM workers. Many others have also occurred that were contained in the immediate vicinity of the test area. Measures would be taken to prevent fires and, should a fire occur, the effects would be reduced by activating fire fighting facilities in the test area (DOE 1995a, SNL/NM 1993d, SNL/NM 1998i).
- *Natural Phenomena*—Naturally occurring events such as tornadoes, lightning, floods, and heavy snow, as documented in existing SNL/NM safety documentation, were considered for their potential to

Table 5.5.8–7. Potential Impacts of Chemical Accidents Under the Reduced Operations Alternative

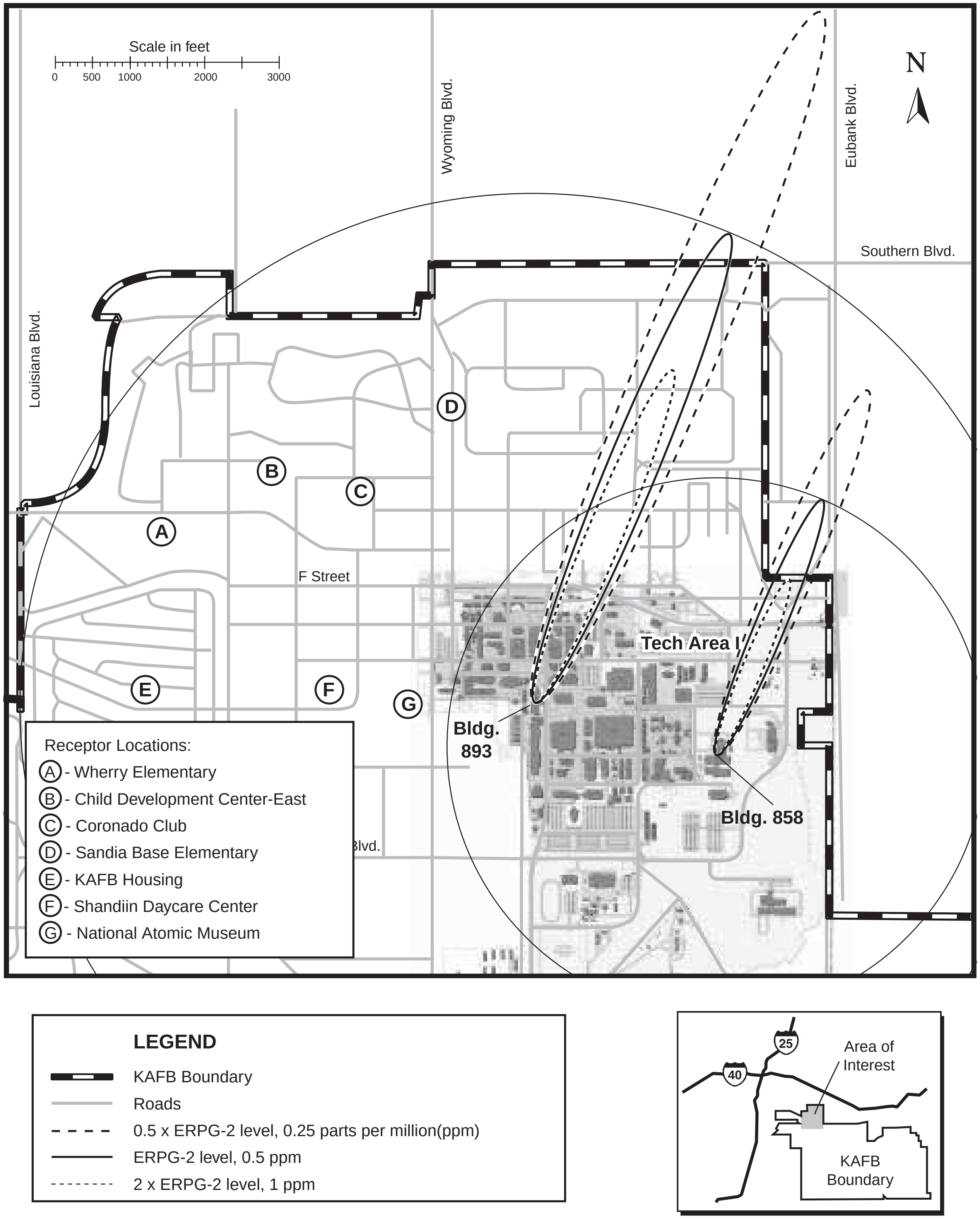
BUILDING	CHEMICAL	BUILDING INVENTORY SOURCE TERM (lb)	ERPG-2 LEVEL OF CONCERN (ppm)	EXCEEDANCE DISTANCE (ft)	FREQUENCY[a] (PER YEAR)
823	Nitrous oxide	32.17	125	351	$1.0x10^{-3}$ to $1.0x10^{-4}$
858	Chlorine	106.4	3	3,726	$1.0x10^{-3}$ to $9.7x10^{-5}$
869	Nitric acid	18.6	15	666	$1.0x10^{-3}$ to $1.0x10^{-4}$
878	Nitrous oxide	50	125	426	$1.0x10^{-3}$ to $3.2x10^{-5}$
880	Hydrofluoric acid	2	20	NR	$1.0x10^{-3}$ to $1.0x10^{-4}$
883	Phosphine	6.8	0.5	3,357	$1.0x10^{-3}$ to $1.0x10^{-4}$
884	Hydrofluoric acid	10	20	504	$1.0x10^{-3}$ to $1.0x10^{-4}$
888	Fluorine	0.07	1	NR	$1.0x10^{-3}$ to $1.0x10^{-4}$
893	Arsine	65	0.5	6,891	$1.0x10^{-3}$ to $1.0x10^{-4}$
897	Chlorine	4.4	3	699	$1.0x10^{-3}$ to $6.6x10^{-5}$
905	Thionyl chloride	101.1	5	2,067	$1.0x10^{-3}$ to $9.0x10^{-5}$

Source: Original (See also Appendix F, Tables F.3–4 and F.5–2)
ERPG: Emergency Response Planning Guideline
ft: feet
lb: pounds
NR: Not reported; the model did not provide a plume footprint due to near-field unreliability. No population estimates are available.
ppm: parts per million
TA: technical area
[a] Frequency ranges from $1.0x10^{-3}$ for an earthquake in TA-I to $1.0x10^{-4}$ for an aircraft crash into a generic building in TA-I, or a lower number based on an aircraft crash described in Appendix F.5.
823 Systems Research and Development
858 Microelectronics Development Laboratory
869 Industrial Hygiene Instrumentation Laboratory
878 Advanced Manufacturing Processes Laboratory
880 Computing Building
883 Photovoltaic Device Fabrication Laboratory
884 6-MeV Tandem Van der Graaf Generator
888 Lightening Simulation Facility Laboratory
893 Compound Semiconductor Research Laboratory
897 Integrated Materials Research Laboratory
905 Explosive Component Facility

Table 5.5.8–8. Impacts of Chemical Accidents on Individuals Within KAFB

BUILDING	CHEMICAL NAME	RELEASE (lb)	ALOHA DISTANCE REQUIRED TO REACH ERPG-2 LEVEL (ft)	NUMBER OF PEOPLE WITHIN ERPG-2
823	Nitrous oxide	32.17	351	2
858	Chlorine	106.41	3,726	141
869	Nitric acid	18.6	666	6
878	Nitrous oxide	50	438	3
880	Hydrofluoric acid	2	NR	NR
883	Phosphine	6.8	3,357	100
884	Hydrofluoric acid	10	504	2
888	Fluorine	0.07	NR	NR
893	Arsine	65	6,891	409
897	Chlorine	4.4	699	5
905	Thionyl chloride	101.1	2,067	55

Source: Original [See also Appendix F, Table F.3–6]
ALOHA: Areal Locations of Hazardous Atmospheres (model)
ERPG: Emergency Response Planning Guideline
NR: Not reported, the model did not provide a plume footprint due to near-field unreliability estimates.
ft: feet
lb: pound
823 Systems Research and Development
858 Microelectronics Development Laboratory
869 Industrial Hygiene Instrumentation Laboratory
878 Advanced Manufacturing Processes Laboratory
880 Computing Building
883 Photovoltaic Device Fabrication Laboratory
884 6-MeV Tandem Van der Graaf Generator
888 Lightning Simulation Facility Laboratory
893 Compound Semiconductor Research Laboratory
897 Integrated Materials Research Laboratory
905 Explosive Components Facility



Source: Original
Note: see Appendix F.3, Table F.3–4

Figure 5.5.8–2. Areas above Emergency Response Planning Guideline 2 from Accidental Releases of Arsine (Building 893) and Chlorine (Building 858)

The circled areas represent locations that could be above ERPG-2, depending on wind direction, for an accidental release of arsine (Building 893) or chlorine (Building 858) under the Reduced Operations Alternative.

initiate the accidental release of radioactive, chemical, and other hazardous materials that affect workers and the public. Any of these events, should they occur, could also lead to serious injury or fatality because of the physical and destructive forces associated with the events. The risks of such events to workers and the public would be equivalent to everyday risks from naturally occurring events to the general public wherever they work and reside.

- *Spills and Leaks*—The potential would exist throughout SNL/NM for the accidental spill of radioactive, chemical, or other hazardous materials. The effects of such spills on workers and the public through airborne pathways were considered earlier in this section. The impacts from pathways other than airborne would normally be bounded by exposure from airborne pathways. Any spill of a hazardous substance would have the potential for impacts to the nonhuman elements of the environment. A spill could make its way into surface and groundwater systems, affecting water quality and aquatic life. Spills of flammable substance could cause fires that damage plant and animal life and other land resources. There have been spills of hazardous substances at the SNL/NM site that had the potential to affect the nonhuman elements of the environment. In 1994, over 100 gal of oil were spilled at the Centrifuge Complex in TA-III when a hydraulic pump failed during a centrifuge test causing a potential impact to the nonhuman elements of the environment. In addition, in 1994, a small spill of transformer oil occurred from an oil storage tank in TA-IV when a gasket failed and, at the Coyote Test Field, a leaking underground storage tank containing ethylene glycol was discovered.
- *Radiological and Chemical Contamination*—Some accidents analyzed in this section and others, that were considered but not analyzed, could potentially affect the nonhuman elements of the environment. Any accidentally released chemicals would result in concentrations that would typically decrease with increasing distance from the point of release. While chemical concentrations would diminish over distance to a point where a human hazard would no be longer present, the concentrations could still affect other elements of the environment such as the ecology, water quality, and cultural resources. Radiological releases could also affect nonhuman elements of the environment. After an accident, SNL/NM, through their spill and pollution control and radiological emergency response plans, would be required to assess the potential for ground contamination; if contamination exceeds guidance levels, plans would be developed for remediation.
- *Industrial*—Besides radioactive and chemical materials and explosives, many SNL/NM facilities conduct operations and use materials and equipment that could also be potentially hazardous to workers. These hazards are typically referred to as normal industrial hazards, not unlike similar hazards that workers are exposed to throughout the nation, and include working with electricity, climbing ladders, welding, and driving forklifts. All operations and activities at SNL/NM facilities, as well as all DOE facilities, would be subject to administrative procedures and safety features designed to prevent accidents and mitigate their consequences should they occur.

5.5.9 Transportation

Under the Reduced Operations Alternative, transportation impacts were assessed for each of three ROIs: KAFB; major Albuquerque roadways; and major roadways between Albuquerque and specific waste disposal facilities, vendors, and other DOE facilities. This analysis involved estimating the number of trips made by SNL/NM-associated vehicles under normal operations in each of these transportation corridors. Transportation evaluators and activity multipliers are discussed in Section 5.3.9, Appendix A, and Appendix G.

5.5.9.1 Transportation of Material and Wastes

The number of material shipments received by SNL/NM is generally proportional to total SNL/NM material consumption. According to facility projections, material consumption under the Reduced Operations Alternative is projected to decrease by 54 percent from current levels. Thus, total material shipments would also decrease, although not necessarily for all types of material.

Radioactive and explosive material shipments are often delivered through government carriers, unless the quantities and activities being transported are low enough to meet the Federal guidelines and restrictions in place for authorized commercial transporters. Government carriers operate on an as-needed basis, thus the general decrease in material inventory under the Reduced Operations Alternative would result in a similar decrease in these kinds of shipments.

Due to their shipment method, there would be very little impact to the number of chemical shipments that are made to SNL/NM. JIT chemicals, which are ordered infrequently and in small quantities, are usually shipped to SNL/NM by way of commercial carriers such as Federal Express and UPS. These carriers make daily shipments to SNL/NM to deliver packages other than chemicals, and a slight decrease in the volume of chemicals they handle per shipment would not likely decrease their frequency. Similarly, major chemical vendors who deliver their own material, rather than use a commercial carrier, also generally make daily shipments to SNL/NM. Therefore, any slight decrease in the volume of material that major vendors ship per load would not have an impact on the frequency of those shipments. Thus, chemical shipments would remain at approximately the same level regardless of the fluctuations in material consumption.

Considering the above factors, overall material transportation due to normal operations would increase by 24 percent over current levels. This increase would be due to shipment requirements of the medical isotopes production project. The anticipated changes in annual and daily material shipments for each material category are presented in Table 5.5.9–1. The analysis assumed that SNL/NM has 250 work days per calendar year.

Waste Transportation

The amount of waste shipped from SNL/NM to disposal facilities correlates directly to SNL/NM waste generation levels. Overall offsite waste shipments would increase by 291 percent. Of this increase, 285 percent is considered to be waste currently disposed of at the KAFB landfill. This leaves a real projected increase of 6 percent under the Reduced Operations Alternative. The total anticipated changes in waste shipments during all operations for each type of waste are presented in Table 5.5.9–2 and Appendix G, Table G.3–3.

Specials Projects

Two special project wastes, ER Project and legacy, were addressed separately due to their one-time operation/project status and in order to avoid skewing the SNL/NM normal operations impact. Legacy wastes would be anticipated to account for an additional 18 shipments of LLW, 3 shipments of LLMW, and 2 shipments of TRU/MTRU wastes over the 10-year time frame (see Figures 4.12–1, 4.12–2, and 4.12–3). In 1998 through 2000, the ER Project could account for up to an additional 312 offsite shipments of LLW, 101 offsite shipments of LLMW, 2 offsite shipments of RCRA waste, 5 offsite shipments of TSCA waste, and 75 shipments of nonhazardous waste. Both of these special projects have been included within the total facility risks.

Offsite Receipts and Shipments of Material and Waste

The bounding case for this analysis assumed that each material and waste shipment is composed of two trips: one to and one from SNL/NM. Thus, the total number of trips made by material and waste transporters under this alternative would be 10,374 (total shipments x 2). Assuming that the year is comprised of 250 work days, the average work day traffic within KAFB contributed by these carriers would be 41 trips. This is small compared to 26,349 trips of SNL/NM vehicles entering and exiting KAFB under this alternative (SNL 1996a, SNL/NM 1998a). Therefore, the overall traffic impacts on KAFB from SNL/NM material and waste shipments under the Reduced Operations Alternative would be minimal.

Shipments of Material and Waste in the Albuquerque Area

The total SNL/NM placarded material and waste shipment traffic under this alternative would comprise only 1.2 percent, or 41 shipments per day, of the total placarded truck traffic (1,767) entering the greater Albuquerque area. Although a 43-percent increase in SNL/NM placarded material and waste truck traffic would be expected, this increase would represent the inclusion of waste currently managed at KAFB landfill and new shipments from the MIPP. ER Project and legacy waste are addressed separately under special projects. Thus, the impacts under the Reduced Operations Alternative would be insignificant.

Shipments of Material and Waste Outside of Albuquerque

All material and waste transported to and from SNL/NM from outside of Albuquerque must enter and depart the city by way of Interstate 25 or Interstate 40. Table 5.5.9–3 presents the impacts to those corridors from material and waste shipments under the Reduced Operations Alternative. The specific remote facility locations are listed in Section 4.11. Daily SNL/NM shipment figures were derived for comparison purposes by dividing the annual waste and material shipment totals in Tables 5.5.9–1 and 5.5.9–2 by the approximately 250 work days in a calendar year.

Based on this analysis, overall SNL/NM material and waste shipments would be expected to increase in frequency by 43 percent under this alternative. Furthermore, the reduced SNL/NM truck traffic would only comprise less than 0.013 percent of all traffic

Table 5.5.9–1. SNL/NM Annual Material Shipments Under the Reduced Operations Alternative

MATERIAL TYPE		BASE YEAR[a] ANNUAL SHIPMENTS	REDUCED OPERATIONS ANNUAL SHIPMENTS
Radioactive		305	140
Radioactive (medical isotopes production)	*Receiving*	0	2
	Shipping	0	1,140
Chemical		2,750	2,750
Explosive		303	138
TOTAL		**3,358**	**4,170**

Sources: SNL/NM 1997b, 1998a

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

Table 5.5.9–2. Annual Waste Shipments Under the Reduced Operations Alternative

WASTE TYPE	BASE YEAR SHIPMENTS	REDUCED OPERATIONS SHIPMENTS
LLW[a] (1996)	4	8
LLMW (1996)	1	3
Hazardous (RCRA+TSCA) (1997)	102	95
Recyclable (Hazardous and Nonhazardous)[a,b] (1997)	86	8
Solid (Municipal, Construction, and Demolition)[b] (1997)	51	650

Sources: Rinchem 1998a; SNL/NM 1998a, 1998y, n.d. (d)
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] Excludes decontamination and decommissioning
[b] Recyclable and solid wastes currently handled by the KAFB landfill could be shipped offsite in the future, contributing an additional 741 shipments.

Table 5.5.9–3. 24-Hour Placarded Material and Waste Traffic Counts Under the Reduced Operations Alternative

ROUTE (ALL TRAFFIC)[a]	BASE YEAR[b]	REDUCED OPERATIONS
I-25 North (52,400)	230	268
I-25 South (18,000)	94	110
I-40 West (16,400)	621	725
I-40 East (54,200)	569	664
TOTAL (141,000)	**1,514**	**1,767**
SNL/NM[c]	**14.5**	**20.7**

Sources: Scientific Services 1995; SNL/NM 1997b, 1998a
I: Interstate
[a] Total vehicle count for all types of vehicles entering and departing Albuquerque
[b] The base year varies depending on information provided in the Facilities and Safety Information Document (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[c] SNL/NM placarded trucks

(165,000 vehicles per day), including all types of vehicles, projected to be entering and departing Albuquerque by way of interstates. For the base year (1996 or 1997), waste leaving Albuquerque represented 35 percent of the total shipments, with an additional 20 percent going to Rio Rancho. Because most materials are supplied through the JIT vendors, origination points are generally not known. However, most vendors use local suppliers; therefore, in the base year, 82 percent of material was assumed to be provided locally, with the remaining 18 percent coming from outside Albuquerque. Thus, the impact to this ROI from the Reduced Operations Alternative would be insignificant.

5.5.9.2 Other Transportation (Traffic)

Overall vehicular traffic impacts under the Reduced Operations Alternative were assessed by projecting the total number of SNL/NM commuter vehicles that would be traveling to and from SNL/NM. The term commuter includes all vehicles operated by SNL/NM employees, contractors, and visitors; DOE employees; and additional traffic, such as delivery vehicles.

Traffic on KAFB

Table 5.5.9–4 presents general anticipated traffic impacts at KAFB under the Reduced Operations Alternative. The number of SNL/NM commuter vehicles traveling to and from the site each work day was conservatively assumed to decrease at the same rate as the SNL/NM work force levels (see Section 5.5.12). Based on this analysis, overall KAFB traffic would decrease by 1 percent under this alternative.

Table 5.5.9–5 shows projected 24-hour KAFB vehicular flow for each of the three main gates under the Reduced Operations Alternative. It was assumed that the Carlisle and Truman gates would be used primarily by KAFB

Table 5.5.9–4. KAFB Daily Traffic Projections Under the Reduced Operations Alternative

COMPONENT	BASE YEAR[a]			REDUCED OPERATIONS			CHANGE (%)
	%	VEHICLES	TRIPS	%	VEHICLES	TRIPS	
SNL/NM Commuters	36	13,582	27,164	35	13,174	26349	-3
KAFB Commuters	64	24,145	48,290	65	24,145	48,290	0
TOTAL KAFB COMMUTER TRAFFIC	**100**	**37,727**	**75,453**	**100**	**37,319**	**74,639**	**-1**
SNL/NM Waste & Material Transporters	0.04	14.5	29	0.06	20.7	41	+43[b]

Sources: SNL/NM 1997a, 1997b

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

[b] This increase represents inclusion of waste currently managed at the KAFB landfill and new shipments from the medical isotopes production project.

Table 5.5.9–5. Total KAFB Gate Traffic Under the Reduced Operations Alternative

GATE	BASE YEAR[a]			REDUCED OPERATIONS ALTERNATIVE			% CHANGE GATE TOTAL
	24-HOUR SNL/NM[b]	24-HOUR TOTAL[c]	PEAK HOUR[d]	24-HOUR SNL/NM	24-HOUR TOTAL	PEAK HOUR	
Wyoming	7,141	19,835	1,941	6,927	19,621	1,922	-1
Eubank	5,324	14,788	2,683	5,164	14,626	2,656	-1
Gibson	8,108	22,523	1,571	7,865	22,280	1,555	-1

Sources: USAF 1995e; SNL/NM 1997a, 1997b

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

[b] SNL/NM commuter and transporter trips per day equals 36 percent of total KAFB trips per day

[c] Total KAFB trips per day

[d] Total KAFB trips per hour, 1996 traffic counts

personnel and not by SNL/NM employees. For the bounding case for this analysis, it was assumed that the SNL/NM contribution to total KAFB flow at each gate would fluctuate by the same factor as the total fluctuation in SNL/NM traffic under the Reduced Operations Alternative. Based on this analysis, the daily KAFB gate traffic would decrease by 1 percent under the Reduced Operations Alternative. This minimal change would not have an appreciable impact on the level of service at the gates.

Traffic in the Albuquerque Area

To determine the traffic impacts in the Albuquerque traffic corridor, roadways most likely to be affected by SNL/NM traffic were selected for analysis. The bounding case used the projected SNL/NM traffic contributions from Table 5.5.9–5 to approximate the SNL/NM component of the total traffic count for each roadway. For worst-case impacts, the SNL/NM traffic component was assumed to be equivalent to the total SNL/NM traffic at the nearest gate. In actuality, a significant percentage of traffic would likely diffuse onto other nearby roads, which would greatly reduce the magnitude of the SNL/NM component. The projected impacts to these roadways under the Reduced Operations Alternative, according to the bounding case factors, are presented in Table 5.5.9–6.

Based on this analysis, there would be a 3 percent overall average decrease in the SNL/NM traffic component on these roadways under the Reduced Operations Alternative. There would also be a 0.8 percent decrease in the total vehicular traffic.

Traffic Outside of Albuquerque

The additional local SNL/NM traffic under the Reduced Operations Alternative would have minimal impacts on transportation routes between Albuquerque and other DOE facilities, vendors, and disposal facilities (see Section 4.11 for a list of these facilities). In a worst-case assessment, the SNL/NM component represents an average 19 percent of the total traffic count (144,000 vehicles per day) on major roadways entering and departing Albuquerque in the base year (MRGCOG 1997b). Under the Reduced Operations Alternative, the SNL/NM component would decrease to 16 percent of total vehicular traffic due to the increase in Albuquerque population and commuters. This assumes that all SNL/NM traffic would actually enter and depart Albuquerque by way of the interstates every day, although a significant portion of SNL/NM traffic would more likely diffuse onto other roadways or remain in Albuquerque.

5.5.9.3 Transportation Risks Associated with Normal Operations

Incident-Free Exposure

The representative conservative cases for this analysis used the distances traveled by SNL/NM waste and material carriers, as listed in Table 5.3.9–7. These distances were based on the average distance traveled by trucks in route to other facilities under all alternatives.

Truck emissions impacts are a function of the number of truck shipments to and from SNL/NM. The bounding case for truck emissions impact analysis assumed that the greatest risk is when these shipments are transported through urban areas, such as the Albuquerque transportation corridor, because these areas are most susceptible to emissions related problems. To evaluate the actual risk associated with SNL/NM truck shipments, the most common origins and destinations of all shipments of concern were compiled to determine the urban distance each material or waste would be transported (Section 4.11). Table 5.5.9–7 presents projected truck emissions impacts resulting from the Reduced Operations Alternative.

The radiological impact of exposure to incident-free routine transportation of radioactive materials was analyzed using *RADTRAN 4* (SNL 1992a), as described in Appendix G. Routes and population densities were modeled using *HIGHWAY* (Johnson et al. 1993). Results of these calculations are presented in Table 5.5.9–8.

This table shows that the LCFs due to annual shipments of radioactive material and wastes under the Reduced Operations Alternative would decrease appreciably although the magnitude is small.

In the absence of an accident that compromises package integrity, no incident-free chemical or explosive exposure would be foreseen to affect the public, workers, or vehicle transport crews under this alternative.

5.5.9.4 Transportation Risks Associated with Accidents

General Accidents

The bounding case for general vehicular traffic impacts under the Reduced Operations Alternative assumed that the percent decrease in accidents would

Table 5.5.9–6. Albuquerque Daily Traffic Counts Under the Reduced Operations Alternative

ROADWAY		BASE YEAR[a]		REDUCED OPERATIONS		% CHANGE
		DAILY[b]	PEAK[c]	DAILY	PEAK	DAILY
Gibson west at Louisiana	***TOTAL***	15,671	2,066	15,428	2,034	-1.6
	SNL/NM	8,108	1,069	7,865	1,037	-3
	% SNL/NM	52		51		-2
Wyoming south of Lomas	***TOTAL***	37,639	2,293	37,853	2,280	-0.6
	SNL/NM	7,141	435	6,927	423	-3
	% SNL/NM	19		18.6		-2
Eubank south of Copper	***TOTAL***	14,572	1,852	14,732	1,832	-1.1
	SNL/NM	5,324	677	5,164	657	-3
	% SNL/NM	37		36		-3
Interstate 25 at Gibson[d]	***TOTAL***	91,000		91,243		-0.3
	SNL/NM	8,108		7,865		-3
	% SNL/NM	8.9		8.6		-3
Interstate 40 at Eubank[d]	***TOTAL***	90,300		90,460		-0.2
	SNL/NM	5324		5,164		-3
	% SNL/NM	5.9		5.7		-3
Wyoming north of KAFB gate	***TOTAL***	20,272	1,749	20,486	1,731	-1.0
	SNL/NM	7,141	612	6,927	594	-3
	% SNL/NM	35		34		-3

Sources: MRGCOG 1997b, 1997c; SNL/NM 1997b, 1998a; UNM 1997b

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

[b] Vehicles per day, *1996 Traffic Flows for the Greater Albuquerque Area*

[c] Vehicles per hour, *1996–1998 Traffic Counts*

[d] Peak hour counts for this intersection are not available

Table 5.5.9–7. Reduced Operations Alternative Incident-Free Exposure: Truck Emissions

CARGO	UNIT RISK[a] FACTOR PER URBAN KILOMETER	URBAN DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER ROUND TRIP SHIPMENT	ANNUAL NO. SHIPMENTS		ANNUAL LCFs	
				BASE YEAR[a]	REDUCED OPERATIONS	BASE YEAR[b]	REDUCED OPERATIONS
NORMAL ROUTINE OPERATIONS							
RAD Materials	1.0×10^{-7}	73.0	1.5×10^{-5}	305	140	4.6×10^{-3}	2.1×10^{-3}
Explosives	1.0×10^{-7}	48.0	9.6×10^{-6}	303	138	2.9×10^{-3}	1.3×10^{-3}
Chemicals	1.0×10^{-7}	8.0	1.6×10^{-6}	2,750	2,750	4.4×10^{-3}	4.4×10^{-3}
LLW	1.0×10^{-7}	33.0	6.6×10^{-6}	4	8	2.6×10^{-5}	5.3×10^{-5}
Medical Isotopes Production (receipts)	1.0×10^{-7}	NA	NA	0	2	NA	3.5×10^{-4}
Medical Isotopes Production (shipments)				0	1,140		
LLMW (shipments)	1.0×10^{-7}	40.6	8.1×10^{-6}	1	3	8.1×10^{-6}	2.4×10^{-5}
LLMW (receipts)	1.0×10^{-7}	35.6	7.1×10^{-6}	0	1	7.1×10^{-6}	7.1×10^{-6}
Hazardous Waste	1.0×10^{-7}	33.0	6.6×10^{-6}	64	58	4.2×10^{-4}	3.8×10^{-4}
Recyclable Hazardous to California	1.0×10^{-7}	23.0	4.6×10^{-6}	2	2	9.2×10^{-6}	9.2×10^{-6}
Recyclable Hazardous to New Mexico	1.0×10^{-7}	6.4	1.3×10^{-6}	6	6	7.8×10^{-6}	7.8×10^{-6}
Solid Waste	1.0×10^{-7}	10.0	2.0×10^{-6}	51	51	1.0×10^{-4}	1.0×10^{-4}
D&D Hazardous Waste TSCA-PCBs	1.0×10^{-7}	33.0	6.6×10^{-6}	1	1	6.6×10^{-6}	6.6×10^{-6}
D&D Hazardous Waste TSCA-Asbestos	1.0×10^{-7}	10.0	2.0×10^{-6}	14	14	2.8×10^{-5}	2.8×10^{-5}
Biohazardous Waste	1.0×10^{-7}	24.0	4.8×10^{-6}	1	1	4.8×10^{-6}	4.8×10^{-6}
Recyclable D&D Hazardous Waste	1.0×10^{-7}	6.4	1.3×10^{-6}	22	22	2.9×10^{-5}	2.9×10^{-5}
Recyclable Nonhazardous Solid Waste	1.0×10^{-7}	6.4	1.3×10^{-6}	78	78	1.0×10^{-4}	1.0×10^{-4}
Nonhazardous Landscaping Waste	1.0×10^{-7}	10	2.0×10^{-6}	NA	142	NA	2.8×10^{-4}

Table 5.5.9–7. Reduced Operations Alternative Incident-Free Exposure: Truck Emissions (concluded)

CARGO	UNIT RISK[a] FACTOR PER URBAN KILOMETER	URBAN DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER ROUND TRIP SHIPMENT	ANNUAL NO. SHIPMENTS		ANNUAL LCFs	
				BASE YEAR[a]	REDUCED OPERATIONS	BASE YEAR[b]	REDUCED OPERATIONS
Construction and Demolition Solid Waste	$1.0x10^{-7}$	10	$2.0x10^{-6}$	NA	599	NA	$1.2x10^{-3}$
RCRA Hazardous Waste (Receipt)	$1.0x10^{-7}$	3	$6.0x10^{-7}$	12	25	$7.2x10^{-6}$	$1.5x10^{-5}$
LLW (D&D)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	4	4	$2.6x10^{-5}$	$2.6x10^{-5}$
TOTAL[c]						**$1.33x10^{-2}$**	**$1.1x10^{-2}$**
SPECIAL PROJECT OPERATIONS							
TRU/MTRU	$1.0x10^{-7}$	8.4	$1.7x10^{-6}$	0	2	0	$3.4x10^{-6}$
TRU/MTRU (legacy)	$1.0x10^{-7}$	8.4	$1.7x10^{-6}$	0	2	0	$3.4x10^{-6}$
LLW (legacy)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	56	0	$3.7x10^{-4}$
LLMW (legacy)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	0	8	0	$6.5x10^{-5}$
LLW (ER)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	136	0	$9.0x10^{-4}$
LLMW (ER)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	0	5	0	$4.1x10^{-5}$
Hazardous Waste (ER)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	0	113	0	$7.5x10^{-4}$
Nonhazardous Solid Waste (ER)	$1.0x10^{-7}$	10	$2.0x10^{-6}$	0	9	0	$1.8x10^{-5}$
TOTAL[c]						**0**	**$2.1x10^{-3}$**

Sources: DOE 1996h; SNL 1992a; SNL/NM 1982, 1997b, 1998a
D&D: decontamination and decommissioning
ER: environmental restoration
km: kilometer
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
NA: not applicable
PCB: polychlorinated biphenyl
RAD: radiological
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] LCFs per km of urban travel
[b] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[c] Lifetime estimated total LCFs

Table 5.5.9–8. Doses to Crew and Public Under the Reduced Operations Alternative

CARGO	ANNUAL DOSE/TRUCK CREW (person-rem)		ANNUAL DOSE/GENERAL PUBLIC (person-rem)		ANNUAL LCFs	
	BASE YEAR[a]	REDUCED OPERATIONS	BASE YEAR[a]	REDUCED OPERATIONS	BASE YEAR[a]	REDUCED OPERATIONS
NORMAL ROUTINE OPERATIONS						
RAD Materials[b]	9.8	4.5	82.4	37.8	$4.5x10^{-2}$	$2.1x10^{-2}$
LLW	0.21	0.41	0.6	1.2	$3.8x10^{-4}$	$7.6x10^{-4}$
LLMW[c]	$1.6x10^{-4}$	$5.9x10^{-4}$	$1.6x10^{-3}$	$6.4x10^{-3}$	$8.6x10^{-7}$	$3.4x10^{-6}$
Medical Isotopes Production	0	0.92	0	2.7	0	$1.7x10^{-3}$
LLW (D&D)	0.21	0.21	0.60	0.60	$3.8x10^{-4}$	$3.8x10^{-4}$
TOTAL[d]					**$4.6x10^{-2}$**	**$2.4x10^{-2}$**
SPECIAL PROJECT OPERATIONS						
TRU/MTRU[e]	0	$3.2x10^{-3}$	0	$1.8x10^{-2}$	0	$1.0x10^{-5}$
TRU/MTRU[e] ***(Legacy)***	0	$3.2x10^{-3}$	0	$1.8x10^{-2}$	0	$1.0x10^{-5}$
LLW (Legacy + ER)	0	10.0	0	28.8	0	$1.8x10^{-2}$
LLMW[c] ***(Legacy + ER)***	0	$2.1x10^{-3}$	0	$2.1x10^{-2}$	0	$1.1x10^{-5}$
TOTAL[d]					**0**	**$1.8x10^{-2}$**

Sources: DOE 1996h, SNL 1992a, SNL/NM 1997b, 1998a
Ci: Curies
D&D: decontamination and decommissioning
ER: environmental restoration
kg: kilograms
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
RAD: radiological
rem: roentgen equivalent, man
TRU: transuranic

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Shipment consisted of 100 kg of depleted uranium
[c] 1996 shipment of 7.2410^{-6} Ci of Sodium-24; Transport Index (TI)= 0.1
[d] Lifetime estimated total LCFs
[e] 1997 shipment of americium-241, europium-152, cesium-137; Transport Index (TI)= 1.0

be equal to the percent decrease in SNL/NM traffic. Therefore, SNL/NM traffic accidents would decrease by 3 percent under this alternative.

Hazardous Material Waste-Related Accidents

The SNL/NM material and waste shipments projected in Table 5.5.9–1 and Table 5.5.9–2 were used in conjunction with traffic fatality statistics (SNL 1986) to project the truck accident fatality incidence rate that would be expected under the Reduced Operations Alternative. The details are presented in Appendix G. These impacts are presented in Table 5.5.9–9. Based on this analysis, accident fatalities due to SNL/NM truck transportation would decrease from 0.22 to 0.18 under this alternative.

Radiological Transportation Accidents

The annual risk to population due to transportation accidents that could involve radiological releases resulting from the Reduced Operations Alternative are presented in Table 5.5.9–10. This analysis indicates that under normal routine operations, LCFs would decrease from $1.2x10^{-3}$ to $5.5x10^{-4}$ incidents due to the worst-case radiological transportation accident under the Reduced Operations Alternative. In addition, $5x10^{-5}$ LCFs would result from legacy and ER Project waste shipments. For more information see Appendix G.

Risks due to radiological, chemical and explosives accidents are evaluated in detail in Appendix F. The bounding transportation accident analysis involves explosion of a tractor-trailer containing 40,000 ft^3 of hydrogen. Based on the results presented in Appendix F, Table F.4–1, the hydrogen explosion would result in structural damage to buildings up to a distance of 91 m from the truck. Fatalities would result up to a distance of 15 to 18 m from the truck, while eardrum ruptures would occur up to a distance of 36 m from the truck.

Table 5.5.9–9. Truck Transportation Traffic Fatalities Under the Reduced Operations Alternative

CARGO	TRAFFIC FATALITY RATE: CREW AND GENERAL PUBLIC PER SHIPMENT (ROUND TRIP)	ANNUAL FATALITIES	
		BASE YEAR[a]	REDUCED OPERATIONS
NORMAL ROUTINE OPERATIONS			
RAD Materials	$3.5x10^{-4}$	0.11	$4.9x10^{-2}$
Explosives	$2.9x10^{-4}$	$8.8x10^{-2}$	$4.0x10^{-2}$
Chemicals	$2.1x10^{-6}$	$5.8x10^{-3}$	$5.8x10^{-3}$
LLW	$2.2x10^{-4}$	$8.8x10^{-4}$	$1.8x10^{-3}$
Medical Isotopes Production	NA	NA	$7.7x10^{-4}$
LLMW (shipments)	$3.0x10^{-4}$	$3.0x10^{-4}$	$9.0x10^{-4}$
LLMW (receipts)	$2.1x10^{-4}$	0	$2.1x10^{-4}$
Hazardous Waste	$2.2x10^{-4}$	$1.4x10^{-2}$	$1.3x10^{-2}$
Recyclable Hazardous to California	$1.5x10^{-4}$	$3.0x10^{-4}$	$3.0x10^{-4}$
Recyclable Hazardous to New Mexico	$1.6x10^{-7}$	$9.6x10^{-6}$	$9.6x10^{-6}$
Solid Waste	$2.6x10^{-6}$	$1.3x10^{-5}$	$1.3x10^{-4}$
D&D Hazardous Waste TSCA-PCBs	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$
D&D Hazardous Waste TSCA-Asbestos	$2.2x10^{-5}$	$3.1x10^{-4}$	$3.1x10^{-4}$
Biohazardous Waste	$1.4x10^{-4}$	$1.4x10^{-4}$	$1.4x10^{-4}$
Recyclable D&D Hazardous Waste	$1.6x10^{-6}$	$3.5x10^{-5}$	$3.5x10^{-5}$
Recyclable Nonhazardous Solid Waste	$1.6x10^{-6}$	$1.2x10^{-4}$	$1.2x10^{-4}$
Nonhazardous Landscaping Waste	$2.6x10^{-6}$	NA	$3.7x10^{-4}$
Construction and Demolition Solid Waste	$2.6x10^{-6}$	NA	$1.6x10^{-3}$
RCRA Hazardous Waste (receipt)	$6.7x10^{-7}$	$8.0x10^{-6}$	$1.7x10^{-5}$
Low-level waste (D&D)	$2.2x10^{-6}$	$8.8x10^{-4}$	$8.8x10^{-4}$
TOTAL[b]		**0.22**	**0.11**
SPECIAL PROJECT OPERATIONS			
TRU/MTRU	$1.9x10^{-5}$	0	$3.8x10^{-5}$
TRU/MTRU (Legacy)	$1.9x10^{-5}$	0	$3.8x10^{-5}$
LLW (Legacy)	$2.2x10^{-4}$	0	$1.2x10^{-2}$

Table 5.5.9–9. Truck Transportation Traffic Fatalities Under the Reduced Operations Alternative (concluded)

CARGO	TRAFFIC FATALITY RATE: CREW AND GENERAL PUBLIC PER SHIPMENT (ROUND TRIP)	ANNUAL FATALITIES	
		BASE YEAR[a]	REDUCED OPERATIONS
LLMW (Legacy)	$3.0x10^{-4}$	0	$2.4x10^{-3}$
LLW (ER)	$2.2x10^{-4}$	0	$3.0x10^{-2}$
LLMW (ER)	$3.0x10^{-4}$	0	$1.5x10^{-3}$
Hazardous Waste (ER)	$2.2x10^{-4}$	0	$2.5x10^{-2}$
Nonhazardous Solid Waste(ER)	$2.6x10^{-6}$	0	$2.3x10^{-5}$
TOTAL[b]		0	$7.1x10^{-2}$

Sources: SNL 1986, 1992a; SNL/NM 1997b, 1998a
D&D: decontamination and decommissioning
ER: environmental restoration
LLW: low-level waste
LLMW: low-level mixed waste
MTRU: mixed transuranic
NA: not applicable
PCB: polychlorinated biphenyl
RAD: radiological
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Lifetime estimated total fatalities from annual shipments and total special project shipments

Table 5.5.9–10. Risks to Population Due to Transportation Radiological Accident, Maximum Annual Radiological Accident Risk for Highway Shipments

CARGO	ANNUAL DOSE RISKS TO POPULATION PERSON-REM		LCFs	
	BASE YEAR[a]	REDUCED OPERATIONS	BASE YEAR[a]	REDUCED OPERATIONS
NORMAL ROUTINE OPERATIONS				
Radioactive Material[b]	2.3	1.1	1.2×10^{-3}	5.5×10^{-4}
LLW	2.3×10^{-3}	4.6×10^{-3}	1.2×10^{-6}	2.3×10^{-6}
LLMW[c]	4.6×10^{-11}	1.7×10^{-10}	2.3×10^{-14} 1.7×10^{-8}	8.5×10^{-14}
Medical Isotopes Production	0	1.9×10^{-3}	0	9.6×10^{-7}
LLW (D&D)	2.3×10^{-3}	2.3×10^{-3}	1.2×10^{-6}	1.2×10^{-6}
TOTAL[d]			**1.2×10^{-3}**	**5.5×10^{-4}**
SPECIAL PROJECT OPERATIONS				
TRU/MTRU[e]	0	3.4×10^{-6}	0	3.4×10^{-9}
TRU/MTRU[e] ***(Legacy)***	0	6.8×10^{-6}	0	3.4×10^{-9}
LLW (Legacy + ER)	0	0.11	0	5.5×10^{-5}
LLMW[d] ***(Legacy + ER)***	0	4.4×10^{-4}	0	2.2×10^{-7}
TOTAL[d]			**0**	**5.5×10^{-5}**

Sources: DOE 1996h; SNL 1992a; SNL/NM 1997b, 1998a
Ci: Curies
D&D: decontamination and decommissioning
ER: environmental restoration
kg: kilograms
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
TRU: transuranic

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Shipment consists of 100 kg of depleted uranium
[c] 1996 shipment of 7.2×10^{-6} Ci of sodium-24; Transport Index (TI)= 0.1
[d] Lifetime estimated total LCFs
[e] 1997 shipment of americium-241, europium-152, cesium-137; Transport Index (TI) = 1.0

5.5.10 Waste Generation

Implementation of the Reduced Operations Alternative would not result in any major changes in the types of waste streams generated onsite. Except for new operations, waste generation levels at SNL/NM would remain constant or decrease slightly, consistent with slight decreases in laboratory operations. These lower waste volumes would be enhanced by the waste minimization and pollution prevention programs, which project a 33-percent overall decrease in total waste disposal needs by FY 2000. Waste projections used for analysis do not take credit for potential waste minimization techniques that have not yet been implemented. Regardless, the decreased generation activities would not exceed current existing waste management disposal capacities.

For projection purposes, the baseline waste generation data were considered to be constant for existing facilities with no major increases or decreases in the amount of wastes generated. Operations waste are considered to be derived from mission-related work. Nonoperations waste are generated from special programs. New operations are discussed separately in order to show the maximum likely existing operational increases. Waste generation levels for special operations waste, such as for the ER Project, are derived separately from the representative facilities' projections under special projects. However, the amount of waste generated is anticipated to reflect proportionally increases or decreases in SNL/NM activity levels over the next 10 years, with the exception of waste to be generated by new programs. The waste quantities projected, listed in Table 5.5.10–1, represent a site-wide aggregate of quantities for each type of waste stream from existing selected facilities. As appropriate, the balance of operations (not selected facilities or special projects) waste generated is discussed within the individual waste sections. Units shown for each waste type are based on how industrial facilities charge commercial clients for disposal of these wastes.

5.5.10.1 Radioactive Wastes

Only three types of radioactive waste, LLW, LLMW, and MTRU waste, would potentially be generated under the Reduced Operations Alternative. SNL/NM would not generate any high-level waste or TRU waste. Projections for waste generation at selected facilities from new and existing operations are presented in Appendix H.

Existing Operations

Under the Reduced Operations Alternative, SNL/NM anticipates a maximum 20 percent decrease in the generation of LLW from existing operations over the next 10 years. LLW generated by SNL/NM is and will continue to be transported offsite to appropriate DOE-approved disposal facilities, such as the NTS. LLMW generation would decrease by 13 percent for existing operations through 2008. Under the *Resource Conservation and Recovery Act Part B, Permit Application for Hazardous Waste Management Units* (SNL/NM 1996a), some treatment of the hazardous component of LLMW could be performed at SNL/NM (Table 4.12–2). LLMW for which no onsite treatment is available would be shipped offsite for treatment and disposal. SNL/NM also projects no TRU waste would be generated annually. The existing TRU/MTRU wastes stored onsite, as well as all future TRU/MTRU wastes, are anticipated to be transferred to LANL for certification, as indicated in the Waste Management Programmatic Environmental Impact Statement (DOE 1997i) ROD (DOE 1998n), prior to disposal at the WIPP. Projected MTRU waste generated would decrease to 0.23 m^3 annually. Existing SNL/NM operations would use less than 1 percent (0.17 percent) annually of the available radioactive waste storage capacity.

New Operations

SNL/NM anticipates a maximum of 10.8 m^3 of LLW would be generated from new operations annually over the next 10 years. The majority of this increase would be primarily due to the full implementation of medical isotopes production operations in 2003. These operations, described in the *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement* (DOE 1996b), would account for over 47 percent of the total projected LLW in the Reduced Operations Alternative. However, due to the nature of the waste, it would be managed at the generation facility to minimize worker exposure until disposal offsite. LLMW generation from all new onsite sources would be a maximum of 0.14 m^3 annually through 2008.

SNL/NM does not expect to generate TRU or MTRU wastes from new operations. Approximately 42 kg of spent fuel would be generated over the 10-year period. Spent fuel is further discussed in Appendix A as a material resource.

Balance of Operations

The waste level for the balance of operations was determined for each type of radioactive waste

Table 5.5.10–1. Total Waste Generation for Facilities Under the Reduced Operations Alternative

ALL WASTE		UNIT	BASE YEAR[a]	REDUCED ALTERNATIVE
RADIOACTIVE WASTE				
Low-Level Waste (500 kg/m³)	Existing Operations	m³(kg)	16(8,000)	18(9,000)
	New Operations	m³(kg)	4(2,000)	11(5,500)
	SNL/NM Balance of Operations	m³(kg)	74(37,000)	74(37,000)
	SNL/NM Total LLW	m³(kg)	94(47,000)	102(51,000)
	Percent change		0.0%	8.8%
Low-Level Mixed Waste (550 kg/m³)	Existing Operations	m³(kg)	3.85(2,120)	3.36(1,850)
	New Operations	m³(kg)	0.20(110)	0.14(80)
	SNL/NM Balance of Operations	m³(kg)	0.28(150)	0.28(150)
	SNL/NM Total LLMW	m³(kg)	4.33(2,380)	3.79(2,080)
	Percent change		0.0%	-12.6%
TRU Waste (310 kg/m³)	Existing Operations	m³(kg)	-	-
	New Operations	m³(kg)	-	-
	SNL/NM Balance of Operations	m³(kg)	-	-
	SNL/NM Total TRU	m³(kg)	-	-
MTRU Waste (76 kg/m³)	Existing Operations	m³(kg)	0.45(34)	0.23(26)
	New Operations	m³(kg)	-	-
	SNL/NM Balance of Operations	m³(kg)	-	-
	SNL/NM Total MTRU	m³(kg)	0.45(34)	0.23(26)
	Percent change		0.0%	-50.0%
RADIOACTIVE WASTE TOTAL[c]	**Existing Operations**	**m³(kg)**	**20.34 (10,154)**	**21.55 (10,876)**
	New Operations	**m³(kg)**	**4.62(2,110)**	**10.96 (5,580)**
	SNL/NM Balance of Operations	**m³(kg)**	**73.92 (37,150)**	**73.92 (37,150)**
	SNL/NM Total Radioactive Waste	**m³(kg)**	**98.88 (49,414)**	**106.42 (53,606)**
	Percent change		**0.0%**	**7.6%**

Table 5.5.10–1. Total Waste Generation for Facilities Under the Reduced Operations Alternative (concluded)

ALL WASTE	UNIT	BASE YEAR[a]	REDUCED ALTERNATIVE
RCRA HAZARDOUS WASTE			
Existing Operations	kg	16,187	15,176
New Operations	kg	398	598
SNL/NM Balance of Operations	kg	39,267	37,349
SNL/NM Total RCRA Hazardous	kg m^3	55,852 44.3	53,123 42.1
Percent change		0.0%	-4.9%
SOLID WASTE			
SNL/NM Total Solid Waste[b]	m^3(kg)	0.6M (2,022)	0.6M (1,955)
Percent change		0.0%	-3.3%
WASTEWATER			
Existing Operations	M gal	49	51
New Operations	M gal	0	3
SNL/NM Balance of Operations	M gal	231	214
SNL/NM Total Wastewater	M gal	280	268
Percent change		0.0%	-4.3%

Sources: SNL/NM 1997b, 1998a, 1998c, 1998t
kg: kilogram
LLMW: low-level mixed waste
LLW: low-level waste
M: million
M gal: million gallons
m^3: cubic meter
MTRU: mixed transuranic
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Individual breakdowns of solid waste for existing, new, and balance of operations are unavailable because of tracking methods.
[c] Numbers are rounded and may differ from calculated values.
Note: Densities shown are found in Table H.3–1.

(Table 5.5.10–1). Only LLW and LLMW would be affected. Balance of operations at SNL/NM would account for an additional 73.6 m^3 per year of LLW. These same operations would account for an additional 0.28 m^3 of LLMW per year. The overall operations impacts for this alternative would increase by 9 percent for LLW and would decrease by 13 percent for LLMW.

Current Capacity

Previously generated radioactive wastes (legacy waste) occupy approximately 494 m^3 of the available 11,866 m^3 of total radioactive waste storage capacity at the RMWMF and its associated storage areas. This represents approximately 4.2 percent of the total available capacity. Therefore, there is sufficient capacity to accommodate the anticipated decrease in radioactive wastes generated.

Special Projects

Projections indicate the ER Project, a special project beyond the scope of normal operations, will actually be the single largest waste generator at SNL/NM in 1998. The ER Project will produce approximately 2,862 m^3 of LLW and 221 m^3 of LLMW, primarily contaminated soil and debris, prior to the end of the project (Table 5.3.10–2). Actual cleanup is now expected to be completed between FY2003 and FY2005 depending on budget availability, with ER Project wastes disposed of. Prior to disposal, ER Project waste must be properly characterized. Therefore, lag time is built into the project schedule between field remediation and actual disposal of waste.

5.5.10.2 Hazardous Waste

Existing Operations

As shown on Table 5.5.10–1, under the Reduced Operations Alternative, SNL/NM anticipates a decrease in the generation of RCRA hazardous waste from 16,187 kg in the base year to 15,176 kg per year. Projections are shown in Appendix H. Projected RCRA hazardous waste generation is presented in Figure 4.12–4.

No appreciable change in the generation of explosive waste would occur. Therefore, the TTF, with a treatment capacity of 9.1 kg of waste per burn, would continue to accommodate those wastes, as discussed in the No Action Alternative. The majority of explosive waste would be disposed of at SNL/NM or through KAFB.

New Operations

SNL/NM anticipates annual generation of a maximum of approximately 600 kg of hazardous waste by new operations over the next 10 years. The increase would be primarily due to the full implementation of medical isotopes production operations associated with the MIPP in 2003. These operations, described in the *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement* (DOE 1996b), would account for less than 2 percent (1.2 percent) of the total projected hazardous waste in 2003 and 2008.

New SNL/NM operations would use less than 1 percent (0.2 percent) annually of the available hazardous waste storage capacity at SNL/NM. This is considered to be a minimal impact.

Balance of Operations

It was assumed that the RCRA hazardous waste levels for the balance of operations at SNL/NM would decrease by the same proportion as RCRA wastes for selected facilities, because facilities represent the overall plant. Consequently, multipliers were used to project RCRA hazardous waste levels under all three alternatives. In the base year, the selected facilities will generate 16,187 kg out of a total of 55,852 kg of all operational RCRA waste. The remainder, 39,267 kg, is the balance of operations RCRA hazardous waste. For the Reduced Operations Alternative, the maximum projected balance of operations amount would be 37,349 kg.

Current Capacity

Under the Reduced Operations Alternative, the total volume of hazardous waste generated at SNL/NM requiring offsite disposal at licensed/approved facilities, would not exceed the existing 286.5 m^3 of storage and handling capacities at the HWMF and its associated storage buildings. The outside nonpermitted bermed storage area for nonhazardous waste was not included in the onsite storage capacity calculations. Hazardous waste is routinely shipped out on a monthly basis to various offsite disposal facilities by SNL/NM. Projections indicate that a maximum of 15.4 percent of the existing hazardous waste capacity would be used. Therefore, a minimum of six years capacity exists for the hazardous waste based on the highest level of generation. Most, if not all, waste would be shipped in less than 1 year to meet regulatory requirements. Based on these projections and continued operations at selected facilities under the Reduced Operations Alternative, the hazardous waste generation impacts would continue to be minimal.

Special Projects

During field remediation, the ER Project, likely the single largest waste generator at SNL/NM in 1998, would produce an additional 26 M kg of hazardous waste by 2002 (Table 5.3.10–2). Final disposal would be accomplished by 2004. ER Project waste must be properly characterized. Therefore, lag time is built into the project schedule between field remediation and actual disposal of waste.

D&D operations would continue (as outlined in Section 2.3.5). This program would directly impact the quantity of TSCA hazardous waste requiring disposal. Under this modernization program, SNL/NM would continue to generate TSCA hazardous waste, primarily PCBs and asbestos that are removed from transformers and buildings. Since the main PCB relamping and transformer removal is now completed, quantities of TSCA waste have dropped to approximately 122,000 kg per year and should remain at that level (Figures 4.12–5 and 4.12–6).

The total volume of TSCA waste would eventually decrease as the targeted facilities are removed. Currently, SNL/NM has 674 buildings providing a total of 5 M gross ft^2 of office and operational space. Through this facility modernization program, the number of buildings would be reduced to 465 buildings totaling approximately 4.9 M gross ft^2. This program would remove 138 buildings accounting for 179,204 gross ft^2 within FY 1998 and FY 1999 at SNL/NM. During FY 2000 through FY 2002, 49 additional buildings accounting for 108,937 gross ft^2 are potentially scheduled for removal. Over the long term, an additional

29 buildings would be removed with a total of 84,132 gross ft^2. To make up for the loss of office and operational space, seven additional buildings would be built, adding approximately 240,000 gross ft^2. No predictions are made for years beyond 2007.

5.5.10.3 All Other Wastes

All SNL/NM operations also involve four additional waste management activity areas, discussed below.

Biohazardous (Medical) Waste

The total volume of medical waste would generally remain a function of the total number of full-time employees and subcontractors located at SNL/NM. Under the Reduced Operations Alternative, approximately 2,423 kg of medical waste would be generated. The existing waste handling capabilities would be adequate to accommodate this waste. No additional offsite impacts would occur, because offsite disposal capacity would continue to be sufficient.

Nonhazardous Chemical Waste

The maximum quantity of nonhazardous waste generated annually at SNL/NM and managed by the HWMF under the Reduced Operations Alternative would be 65,934 kg, based on the waste multiplier (see Appendix A) developed for RCRA waste (Rinchem 1998a). Existing commercial disposal facilities would have adequate capacities to handle the continued generation of nonhazardous waste; thus, no additional impacts would be anticipated.

Municipal Solid Waste

Site-wide solid waste generation trends at SNL/NM would generally remain a function of total building area and the number of full-time and subcontractor employees. This function is based on general build operations activities, such as maintenance and cleaning, and, to a lesser extent, the general office waste created by SNL/NM employees. Over the 10-year time frame, a decrease of 2.2 percent would be anticipated. Despite the projected 3 percent personnel decrease, no appreciable onsite impacts to disposal facilities would be anticipated because existing waste handling capabilities are already in place. As existing buildings are replaced, personnel would be moved to make more efficient use of the space. No additional offsite impacts would occur, since offsite disposal capacity would continue to be sufficient. However, a significant amount of C&D waste, a special class of solid waste, would potentially be generated under the facility modernization program described above. Quantities of C&D waste associated with the facility modernization program were projected to be similar to prior years. This waste would be disposed of at KAFB and would not create an offsite impact. Table 5.3.10–3 summarizes construction debris disposal.

Wastewater

SNL/NM would generate approximately 268 M gal of wastewater annually. However, SNL/NM entered into an MOU with KAFB, the DOE, the city of Albuquerque, and the state of New Mexico to reduce its water use by 30 percent by 2004 (SNL/NM 1997p). The MDL would be the single facility discharging the largest volume of wastewater at SNL/NM. Reduction efforts would focus on the MDL in order to reduce the amount of process wastewater being generated. See Section 5.3.2 for additional discussion of wastewater quantities and capacities.

5.5.11 Noise and Vibration

Implementation of the Reduced Operations Alternative could include activity levels at some facilities that would increase over the 1996 baseline activity levels. In these cases, the activity levels would be those that were not exercised sufficiently during the baseline period to maintain the capability or to satisfy testing requirements of the DOE.

The frequency of impulse noise events under the Reduced Operations Alternative is projected to be 65 percent less than the 1996 baseline level of activity and approximately 75 percent less than the 2008 No Action Alternative level for all test activities combined. This level of activity would result in an average of approximately 1.5 impulse noise tests per day, compared to an average of 5.5 impulse noise tests per day under the 2008 No Action Alternative. Only a small fraction of these tests would be of sufficient magnitude to be heard or felt beyond the site boundary. The vast majority of tests would be expected to be below background noise levels for receptor locations beyond the KAFB boundary and would, therefore, be unnoticed by the neighborhoods bounding the site. These impulse noise levels resemble a dull thud and generally are considered an annoyance because of "startle" effects, including window vibrations. The effects on the public would be minor.

5.5.12 Socioeconomics

The implementation of the Reduced Operations Alternative would result in no noticeable changes in the socioeconomic categories discussed in the following sections. Environmental impacts to demographic characteristics, economy, and community services in the ROI under the Reduced Operations Alternative are discussed below. The discussion of impacts is based on a bounding economic analysis.

5.5.12.1 Demographic Characteristics

The Reduced Operations Alternative would not likely generate a noticeable change in the existing demographic characteristics within the ROI (Section 4.14.3). Under this alternative, overall expenditures and employment at SNL/NM would decrease gradually and then remain constant through 2008.

5.5.12.2 Economic Base

The Reduced Operations Alternative would not be likely to result in a noticeable economic change in the existing economic base within the ROI (Section 4.14.3).

Table 5.5.12–1 presents an estimate of the Reduced Operations Alternative impacts on the ROI economy from a 3-percent decrease in operational levels of activity and associated decreases in expenditures, income, and employment, both direct and indirect, at SNL/NM. Minimal operational activities associated with selected facilities are included in the totals presented in the table. If operations at SNL/NM were to decrease by 3 percent over current levels, overall economic activity and income within the ROI would be expected to decrease by about

Table 5.5.12–1. SNL/NM's Impact on Central New Mexico's Economy if Operations Were to Decrease by 3 Percent

ECONOMIC MEASURE	FY 1996[a]			ASSUMING A 3-PERCENT DECREASE IN OPERATIONS			
	SNL/NM	TOTAL ROI	PERCENT OF ROI	SNL/NM	TOTAL ROI	PERCENT OF ROI	PERCENT CHANGE
ECONOMIC ACTIVITY ($ BILLIONS)							
Direct Expenditures	1.43			1.39			
Indirect & Induced	2.50	**42.4**	**9.3**	2.43	**42.28**	**9.0**	**-0.3**
Total Economic Activity	**3.93**			**3.81**			
Economic Activity Multiplier: 2.75[b]							
INCOME ($ BILLIONS)							
Net Wages & Salaries	0.48			0.47			
Indirect & Induced	0.58	**13.4**	**8.0**	0.56	**13.37**	**7.7**	**-0.3**
Total Income	**1.07**			**1.03**			
Income Multiplier: 2.21[b]							
EMPLOYMENT (NUMBER OF EMPLOYEES)							
SNL/NM Employment	7,652			7,422			
Indirect & Induced	18,826	**331,800**	**8.0**	18,259	**331,004**	**7.6**	**-0.4**
Total Employment	**26,478**			**25,682**			
Employment Multiplier: 3.46[b]							

Source: DOE 1997j
ROI: region of influence
FY: fiscal year

[a] Modeled results from DOE 1997j
[b] The use of multipliers in calculating economic impacts in the ROI is explained in Section 4.14.3.

0.3 percent. As presented in Table 5.5.12–1, a 3-percent decrease in operational levels of activity at SNL/NM through 2008 would result in a decrease from $42.4 B to $42.28 B, amounting to a $120-M total reduction in economic activity (an average loss of $12 M per year). Total income would decrease from $1.07 B to $1.03 B, amounting to a $40-M reduction in total income (an average loss of $4 M per year). Total employment would decrease from 331,800 to 331,004, amounting to a reduction of 796 total jobs (an average loss of 80 jobs per year) in the ROI. By 2008, contributory effects from other industrial and economic sectors within the ROI would reduce or mask some of SNL/NM's effect on the ROI economy (Section 6.4.12).

5.5.12.3 Housing and Community Services

The Reduced Operations Alternative would not be likely to have a noticeable impact on existing housing and community services within the ROI (Section 4.14.3). Under this alternative, overall expenditures and employment at SNL/NM would decrease gradually and then remain constant through 2008. Contributory effects from other industrial and economic sectors within the ROI would reduce or mask the SNL/NM proportional impact.

5.5.13 Environmental Justice

In general, SNL/NM operations under the Reduced Operations Alternative would have no known disproportionately high or adverse health or environmental impacts on minority or low-income populations within the ROI. One area of concern is water resources and hydrology. Anticipated water resources adverse impacts would equally affect all communities in the area (see Section 5.5.4). Thus, no disproportionately high and adverse impacts to minority or low-income communities are anticipated for this resource area.

Table 5.5.13–1 provides a brief summary of environmental justice impacts on each resource or topic area under the Reduced Operations Alternative. It also identifies areas where the impacts do not vary from the No Action Alternative. See Section 5.3.13 for an expanded discussion of environmental justice issues by resource area.

Table 5.5.13–1. Summary of Potential Environmental Justice Impacts Under the Reduced Operations Alternative

RESOURCE OR TOPIC AREA	SUMMARIZED EFFECT	EFFECT ON RESOURCE OR TOPIC AREA ROI	PROPORTIONAL EFFECT ON	
			LOW-INCOME	MINORITY NEIGHBOR-HOODS
Land Use and Visual Resources, Infrastructure, Geology and Soils, Water Resources and Hydrology[a], Biological and Ecological Resources, Cultural Resources, and Waste Generation	Same as under the No Action Alternative	Same as under the No Action Alternative	Same as under the No Action Alternative	Same as under the No Action Alternative
Air Quality–Nonradiological Air	Emissions would be below the most stringent standards, which define the pollutant concentrations below which there are no adverse impacts to human health and the environment. Concentrations would be below regulatory standards and human health guidelines. SNL/NM carbon monoxide emissions would be 5.6% of Bernalillo County carbon monoxide emissions.	Not adverse	Not adverse	Not adverse
Air Quality–Radiological Air	MEI: 0.020 mrem/yr Collective ROI dose: 0.80 person-rem/yr Average collective dose in ROI: $1.1\text{x}10^{-3}$ mrem/yr	Not adverse	Not adverse	Not adverse
Human Health and Worker Safety	MEI lifetime risk of fatal cancer would increase by $8.0\text{x}10^{-9}$ Fatal cancers (additional ROI): $4.0\text{x}10^{-4}$ Risk of cancer fatality to workforce is $4.0\text{x}10^{-3}$	Not adverse	Not adverse	Not adverse
Transportation	Total annual material shipments: 4,170 Total KAFB traffic (daily vehicles): 37,319 Incident-free exposure, truck emissions - annual LCFs: $1.1\text{x}10^{-2}$ Incident-free exposure, dose - annual LCFs: $2.4\text{x}10^{-2}$	Not adverse	Not adverse	Not adverse

Table 5.5.13–1. Summary of Potential Environmental Justice Impacts Under the Reduced Operations Alternative (concluded)

RESOURCE OR TOPIC AREA	SUMMARIZED EFFECT	EFFECT ON RESOURCE OR TOPIC AREA ROI	PROPORTIONAL EFFECT ON LOW-INCOME	PROPORTIONAL EFFECT ON MINORITY NEIGHBOR-HOODS
Noise and Vibration	Test activities would be 85% less than the 1996 level, an average of approximately 1.5 impulse noise tests per week. Only a fraction of these tests would be of sufficient magnitude to be heard or felt beyond the site boundary. The vast majority of tests would be expected to be below background noise levels for receptor locations beyond the KAFB boundary and would, therefore, be unnoticed in neighborhoods bounding the site.	Not adverse	Not adverse	Not adverse
Socioeconomics	SNL/NM employees: 7,422 SNL/NM total economic activity: $3.81 B/yr Percent of ROI total economic activity: 9%	Not adverse	Not adverse	Not adverse

Source: Original
B: billion
LCFs: latent cancer fatalities
MEI: maximally exposed individual
mrem: millirem
ROI: region of influence
TCPs: traditional cultural properties
yr: year
[a] Groundwater withdrawal was considered adverse; however, the effects are not disproportionately high and adverse to low-income and minority neighborhoods.

5.6 MITIGATION MEASURES

The regulations promulgated by the CEQ to implement the procedural provisions of NEPA (42 U.S.C. § 4321) require that an EIS include a discussion of appropriate mitigation measures (40 CFR §1502.14[f] and 16[h]). The term "mitigation" includes the following (40 CFR §1508.20):

- avoiding an impact by not taking an action or parts of an action;
- minimizing impacts by limiting the degree or magnitude of an action and its implementation;
- rectifying an impact by repairing, rehabilitating, or restoring the affected environment;
- reducing or eliminating the impact by preservation and maintenance operations during the life of the action; and
- compensating for the impact by replacing or providing substitute resources or environments.

This section describes mitigation measures by resource area, along with descriptions and key proactive initiatives. These mitigation measures and proactive initiatives address the range of potential impacts of continuing to operate SNL/NM.

SNL/NM operates under existing programs and controls, including regulations, policies, contractual requirements, and administrative procedures, to mitigate impacts. The existing programs and controls are too numerous to list completely. Examples include the Fire Protection Program, Pollution Prevention and Waste Minimization Programs, Water and Energy Conservation Programs, and a Natural Resource Management Plan.

In large part, these programs and controls effectively reduce the need for additional mitigation measures in a majority of resource areas evaluated in the SWEIS. Also, as presented in Chapter 5, the majority of resource area impacts would not pose substantial harm to the environment or the public, and thus mitigation measures would not be required or anticipated. However, several resource areas, including cultural resources and environmental justice, present potential mitigation measures.

The description of these potential mitigation measures does not constitute a commitment to undertake any of them. Any such commitments would be reflected in the ROD following the Final SWEIS, with a more detailed description and implementation plan in a Mitigation Action Plan published following the ROD.

5.6.1 Resource-Specific Mitigation Measures

Resource-specific mitigation measures are discussed below.

5.6.2 Land Use and Visual Resources

No land use or visual resources impacts are anticipated that would require specific mitigation measures. Because land use on KAFB is influenced by a variety of landowners, permit arrangements, and withdrawal agreements, future land use is a complex issue. As a proactive means of developing future use options for properties owned by the DOE or permitted for its use on KAFB, SNL/NM is participating in a Future Use Options Logistics and Support Working Group with the DOE as the lead. Additional members of this group include other DOE affiliates (such as the Lovelace Respiratory Research Institute, Nonproliferation and National Security Institute (NNSI), TSD, KAFB, USFS, NMED, and EPA). Public involvement is encouraged through the DOE/SNL Citizens Advisory Board, which has been instrumental in providing interim recommendations on future land use options. These recommendations recognize the high probability of continued Federal use of KAFB and propose, for future use planning and cleanup level determination, reasonable land use classifications based on residential, recreational, and industrial use (SNL 1997a, Keystone 1995).

Improving the visual quality of SNL/NM is currently accomplished through incorporating Campus Design Guidelines. These guidelines contain a set of principles and detailed design guidance for the physical development and redevelopment of SNL/NM sites. They include guidance for building massing, facades, color palettes, building orientation and entries, circulation corridors, standardized signage, and landscaping, including low-water use plant selections. All new and modified facilities will be brought into compliance with these guidelines over time. They have been endorsed by senior management of SNL/NM and are administered through the Corporate Projects Department, the Sites Planning Department, and the Campus Development Committee (SNL 1997a). Where decommissioning, demolition, or environmental restoration are planned, actions will be taken to restore the area to its approximate natural condition by backfilling, reducing side slopes, applying topsoil, reseeding, and establishing plant growth (SNL/NM 1997a).

5.6.3 Infrastructure

SNL/NM site infrastructure resources are capable of accommodating any of the alternatives with regular maintenance, repair, and upgrades. No mitigation measures would be anticipated.

5.6.4 Geology and Soils

Of the two analyses (slope stability and soil contamination) conducted for the Geology and Soils resource area, negligible environmental impacts were noted. Therefore, no mitigation measures would be required. Slope stability has not been an issue at SNL/NM because of the location of major facilities on relatively level ground and the stable bedrock-dominated mountainous areas. For soil contamination, this finding assumes SNL/NM's continued compliance with applicable regulations regarding the management and disposal of waste. Mitigation measures for potential releases of hazardous or radioactive materials at outdoor testing areas would be part of future operations (SNL 1997e).

5.6.5 Water Resources and Hydrology

Groundwater contamination exists at the CWL as a result of prior waste disposal activities. Groundwater contamination also exists in an area beneath TAs-I and -II, although contamination may not be of SNL/NM origin (see discussion in Section 5.3.4.1). At the Lurance Canyon Burn Site, nitrates exceeding the MCL have been detected in groundwater, but may be naturally occurring. Investigations or cleanup are underway at all of these sites, and further actions will be coordinated with the NMED.

The groundwater quantity analysis established SNL/NM's current and future contribution to local aquifer drawdown to be approximately 11 percent. To mitigate impacts to groundwater supplies, SNL/NM has announced a plan to cut water usage by 30 percent (SNL/NM 1997a). However, the effectiveness of any SNL/NM conservation initiative in reducing aquifer drawdown must be evaluated in the context of SNL/NM's portion of aquifer usage, determined to be approximately 1 percent (see Chapter 6). Accordingly, significant water conservation by SNL/NM will have a limited effect on regional aquifer drawdown.

5.6.6 Biological and Ecological Resources

Surveys for the presence or absence of threatened and endangered species and sensitive species, as well as for migratory bird nests, would be conducted at sites prior to commencing activities that could result in ground disturbance or destruction. If any of these species are encountered at a site, avoidance measures would be implemented. Such measures could include scheduling the activities outside of the breeding season and transplanting populations to another location. Migratory bird nests and birds occupying those nests, which could be affected by the activity, would be removed in accordance with the *Migratory Bird Treaty Act* (MBTA) (16 U.S.C. §703) permit from the USFWS. These thirteen species of birds would include, for example, the western burrowing owl and the gray vireo (see Section 4.7).

5.6.7 Cultural Resources

The likelihood for future discovery or identification of previously unrecorded archaeological sites or TCPs in the ROI is high. At present, there are no identified archaeological sites or TCPs on DOE-administered land within the ROI. If resources were discovered as a consequence of ongoing consultations, the stipulations outlined in the *National Historic Preservation Act* (NHPA) (16 U.S.C. §470 as amended) and its regulations (36 CFR Part 800) would be followed. Activities in the immediate vicinity of the discovery would cease until the significance and disposition of the resource could be determined in consultation with the New Mexico SHPO, Native American tribes with cultural affiliation, and the Advisory Council on Historic Preservation. The inadvertent discovery of Native American human remains or funerary objects (associated or unassociated) would require adherence to the *Native American Graves Protection and Repatriation Act* (NAGPRA) (25 U.S.C. §3001). The activity leading to the discovery would stop and would be delayed for 30 days after certification that notification to the agency or tribes had been received. Protection of the individual or objects *in situ* or while curated would be initiated and continue until disposition of the individual or objects is completed. A notice of the discovery would be sent to the Native American tribes with the closest known cultural affiliation, and direction would be requested for treatment and disposition of the items. For land that is permitted to the DOE by another agency, the stipulations in the permits governing the management and treatment of cultural resources would determine which agency is responsible for each of the steps identified above.

The additional security that is enforced at selected facilities during certain activities would increase protection of archaeological sites and TCPs from inadvertent and intentional damage. Although no specific TCPs have been identified within the ROI, if any are identified on DOE-administered land in the future, access to these sites could become an issue. If TCPs are identified and access is desired, the DOE would consult with the appropriate Native American tribe to develop an agreement and procedure for access to the specific TCP. For lands permitted to the DOE by the USAF or USFS, such agreements would potentially involve multiple Federal agencies. Any agreement would have to take into account the additional security enforced by that particular SNL/NM facility.

5.6.8 Air Quality

5.6.8.1 Nonradiological Air Quality

Mitigation measures to control the emissions of chemical and criteria pollutants would not be required under the alternatives. The health impacts associated with the atmospheric release of chemicals were evaluated in Sections 5.3.8.1, 5.4.8.1, and 5.5.8.1. No health effects were identified.

At this time, SNL/NM has a voluntary program for traffic minimization. The city of Albuquerque provides bus routes that nearly span the city boundaries. Several bus routes include KAFB to provide access to SNL/NM. However, the most significant efforts in car-pooling are exercised by individuals who live in outlying cross-town areas or in Belen or Los Lunas. The SNL/NM van or car pool coordinator provides assistance to potential participants. Both the DOE and SNL/NM allow employees to work on a 9-day work schedule (rather than 10 days) over 2 weeks, thus reducing SNL/NM and DOE commuter traffic as much as 10 percent.

SNL/NM actively promotes alternative transportation for employees to commute to work. Current alternatives include walking, bicycling, riding in a van pool, riding in a car pool, and riding the city bus. SNL/NM encourages its employes to reduce the number of cars coming to the base to provide improved air quality, less traffic congestion, reduced travel time, and fewer parking problems. SNL/NM workforce bicyclists commuted approximately 345,000 miles during the Winter Pollution Advisory Periods the last 3 years, avoiding the production of about 15,600 pounds of carbon monoxide pollution. Employees have used 844-RIDE to learn more about van pools, car pools, and city bus service, or to obtain a city bike path map.

From a national perspective, the *Sandia National Laboratories Institutional Plan* (SNL/NM 1997b) briefly describes energy resource R&D projects, as noted in Section 2.1.2. In 1997, SNL/NM undertook 218 R&D projects using DOE-focused technologies and unique SNL/NM science and engineering capabilities. Nearly 16 percent of the projects had applications that were energy resources-related. For example, Sandia's Combustion Research Facility collaborates with industry on its combustion project and concentrates on reducing noxious emissions and developing improved technologies for internal combustion engines. In addition, SNL/NM has a cooperative R&D agreement with the U.S. Advanced Battery Consortium for development of electric vehicle battery technologies. Sandia scientists and engineers are also developing new materials fuel processing catalysts and improved manufacturing processing for batteries, fuel cells, and supercapacitors.

5.6.8.2 Radiological Air Quality

Under each alternative, the calculated radiological annual dose due to air emissions from SNL/NM operations to the MEI and total population within 50 mi of SNL/NM would be minimal and not expected to have any adverse impacts. Therefore, no mitigation measures would be required.

5.6.9 Human Health and Worker Safety

5.6.9.1 Normal Operations

Adverse human health effects are not expected under any of the alternatives. Therefore, no mitigation measures would be necessary to protect human health.

5.6.9.2 Accidents

DOE operations at SNL/NM are conducted in strict accordance with DOE orders, laws, and regulatory requirements to minimize the chances of an accidental release of chemical and radiological materials. Measures can be taken to prevent accidents and, in the event of an accident, to eliminate, lessen, or compensate for potential impacts. For example, engineered safety features and administrative controls are designed to prevent accidents from occurring or stop the progression of the accident. Other measures taken following an accident would minimize impacts to workers, the public, and the environment. For example, air filtration systems, room and building barriers, and air locks that contain releases of hazardous materials, dikes for controlling spills, fire-fighting equipment, evacuating workers and/or the public, restricting the consumption of contaminated food and water, cleaning up contaminated areas, and restricting public access to contaminated areas are existing means to mitigate the adverse effects of accidents. Specific measures for preventing and mitigating accident impacts depend on the accident scenarios, facility locations, and other factors. For this reason, additional existing mitigation measures and their effects are discussed in the context of specific accidents, where applicable, in Appendix F.

Emergency Preparedness and Emergency Plan

SNL/NM has prepared and maintains an Emergency Plan (SNL/NM 1993e) in accordance with DOE requirements. The plan uses inputs from the HA process, SARs, site development plans, and other documents to establish the basic requirements for emergency response. The plan establishes an Emergency Response Organization that is responsible for minimizing the effect of an emergency incident on people, property, and the environment. SNL/NM maintains a working relationship with offsite authorities. The goal is to share information that might be needed during an event, establish response interfaces, maintain rapport, and share resources when requested for event mitigation. The city of Albuquerque, county of Bernalillo, state of New Mexico, KAFB, U.S. Department of Agriculture, USFS, and the DOE have established roles and responsibilities for emergency response. These include the notification processes for each of the response groups and mutual aid in the event of an emergency. SNL/NM, upon request from the DOE, would respond with technical support to transportation accidents involving radiological and hazardous materials. No emergency response roles are identified between SNL/NM and tribal organizations.

5.6.10 Transportation

5.6.10.1 Normal Operations

The transportation of many different materials and waste streams from SNL/NM operations and projects results in a continuous need for proper packaging, labeling, and manifesting. General transportation requirements are anticipated to decrease in 2003 and 2008, based on full implementation of waste minimization/pollution prevention projects. To minimize the impact to the environment, SNL/NM, whenever possible, would transport full shipments of waste materials offsite for treatment and disposal within the programmatic goals and schedules. Using the JIT procurement system would minimize the quantities of materials transported (for example, more packages, smaller quantities) by using specific chemical providers, thereby reducing the number of trips.

Special projects such as the ER Project and shipments of legacy wastes would, in the short-term, increase total transportation requirements for radioactive and hazardous waste. Mitigation measures for the different wastes are discussed in Section 5.6.11.

5.6.11 Waste Generation

5.6.11.1 Waste Generation

No impacts from waste generation would be anticipated. Therefore, no specific mitigation measures would be required. However, the generation of the many different waste streams from SNL/NM operations and projects poses a continuous need for the proper packaging, labeling, manifesting, transportation, storage, and ultimate disposal of the waste. General waste trends are anticipated to decrease in quantity for 2003 and 2008 based on full implementation of waste minimization/ pollution prevention projects. All waste management is considered to be part of the general infrastructure of SNL/NM and has been identified as such in facility documents.

Radioactive Wastes

As part of the effort to minimize the total quantity of radioactive wastes that are generated at SNL/NM facilities, all wastes originating from a Radioactive Materials Management Area (RMMA) must be identified prior to pickup and disposal. A RMMA is an area where the reasonable potential exists for contamination due to the presence of unconfined or unencapsulated radioactive material, or an area that is exposed to beams or other sources of particles (neutron, proton, and so on) capable of causing activation. Managers of all facilities must document the location of any RMMAs. Procedures to minimize the generation of radioactive wastes are developed with the Generator Interface and Pollution Prevention Department, Health Protection Department, and the Radiation Protection Operation Department.

The ER Project has been the largest single contributor of LLW and LLMW. Based on current program objectives, the ER Project will be completed around 2004, depending on funding of cleanup projects and NMED approval. Once sites are cleaned up, significant reductions in total waste volumes generated are anticipated. Procedures for this project are detailed in the EA for the ER Project (DOE 1996c). ER Project waste generation would be minimized through a detailed sampling analysis. Site-specific restoration details would be negotiated and approved by the DOE and the NMED program to determine contamination of waste materials from ER sites.

Hazardous Waste

Under the DOE and the NMED, RCRA hazardous waste would be closely managed with annual audits to determine SNL/NM's level of compliance. RCRA hazardous waste operations at SNL/NM are covered under a SNL/NM permit. The largest single contributor of RCRA hazardous waste would be the ER Project. Based on current program objectives, the ER Project will be completed around 2004, depending on funding of cleanup projects and state of NMED approval. Once sites are cleaned up, significant reductions in the total waste volumes being generated would be anticipated. Procedures for this project are detailed in the EA for the ER Project (DOE 1996c). Site-specific restoration details would be negotiated and approved by the DOE and the NMED. In order to more effectively handle and treat hazardous waste generated by this program a CAMU has been constructed. This will minimize the amount of waste generated and pollution generated through packaging and transportation operations. Waste generation would be minimized through a detailed sampling analysis program to determine contamination of waste materials from ER sites and treatment requirements.

As TSCA hazardous wastes (PCBs and asbestos) are removed from existing facilities, the total volume of this type of waste material would decrease. Proper sampling and management of TSCA wastes would reduce overall quantities generated at SNL/NM.

Biohazardous Medical Waste

The total volume of biohazardous waste would remain a function of the total number of full-time employees and subcontractors located at SNL/NM. Proper management of biohazardous wastes would reduce overall quantities and the combined cost for disposal of this waste to SNL/NM.

Wastewater

Measures are currently being implemented that will reduce the total process water used, this will directly reduce the wastewater being generated. SNL/NM entered into a MOU with KAFB, the DOE, the city of Albuquerque, and the state of New Mexico to reduce its water use by 30 percent by 2004 (SNL/NM 1997a). The MDL accounts for approximately 90 percent of all process wastewater generated by SNL/NM. Recycling efforts would focus on the MDL in order to reduce the amount of process wastewater being generated. If all of the planned water conservation projects are implemented, 63 to 205 M gal of the current 440 M gal of the water used per year at SNL/NM would be saved. Section 5.3.2 discusses wastewater quantities and capacities. Specific MDL projects are presented below:

MDL Reverse Osmosis Efficiency Improvements

Many MDL operations require high-purity water. Incoming water from KAFB is processed through a water treatment facility that includes the following unit processes: carbon adsorption, reverse osmosis, vacuum degassing, and ion exchange. The production of ultra-pure water before water conservation required 128 M gal of water per year.

The water treatment system of the MDL was modified in 1996 to meet a 30-percent reduction goal. Specifically, the following changes were implemented: new stainless-steel control valves were installed for precise control of water flow; a new manifold was added to the reverse osmosis pump, converting it to a more efficient two-stage pump; high-surface-area reverse osmosis membranes were added; and the existing PVC piping was replaced with industrial, water-production piping.

These modifications cost $107,113 and resulted in an annual reduction of 38 M gal in water use. Annual water and sewer discharge savings were $100,000. The improved reverse osmosis system also reduced the operation hours, saving an additional $22,000.

MDL Water Recycling Project

The MDL Water Recycling Project is funded by SEMATECH, the U.S. semiconductor industry consortium. The project's objective is to document a case history of introducing water recycling into a semiconductor laboratory such as MDL. Water recycling, which could reduce water consumption by 70 percent to 80 percent, has met industry resistance from operational personnel because of the serious risk of product line shutdowns from system contaminants being introduced into the recycle loop.

Project researchers are developing near real-time sensors for detecting organic spikes or excursions in a water recycle loop. Upstream detection will prevent the introduction of contaminants, effectively eliminating the risks associated with recycling spent rinse water. Installation of the common drain system and the collection tanks at MDL is completed. Sensor development and testing continue.

Process Water Reclamation for Cooling Towers at the MDL

Design for this project is complete and the system has been scheduled for construction. The plan for this project is to take some of the process wastewater at the MDL and pump it to an adjacent cooling tower, resulting in a savings of approximately 12 M gal of water per year. The estimated annual cost savings is $25,000. Several technical issues have been addressed, including a chemical analysis of the process wastewater and a corresponding change to the chemical treatment program for the cooling tower.

Water Reduction Project for Cooling Towers

Sandia has 23 cooling tower systems serving 42 chillers. The estimated makeup water for blowdown, evaporation, and drift results in the use of approximately 110 M gal of water per year. The proposed project would change the chemical treatment program and provide instrumentation in the operation of the cooling tower system to reduce water consumption by maximizing the system performance. Approximately 20 M gal of water per year would be saved.

5.6.11.2 Waste Minimization/ Pollution Prevention Program

The Waste Minimization/Pollution Prevention Program is a central element of the SNL/NM Environment Safety and Health management strategy, and day-to-day operations. The program was developed to change the corporate culture, including pollution prevention practices, into everyday activities and tasks. As a result, reducing or eliminating the generation of waste has become an integral part of the philosophy and operations at SNL/NM. SNL/NM developed a formal program plan that provides programmatic guidance, specifying strategies, activities, and methods that are to be employed to reduce the quantity and toxicity of waste and pollutants, to conserve energy and resources, and to encourage the purchase of products with recycled content.

SNL/NM also employs a comprehensive waste minimization program to reduce the quantity of chemical and radioactive wastes generated onsite. The key components of this program are identified in the *SNL/NM Pollution Prevention Plan* (SNL/NM 1997p). These include having senior SNL/NM management committed to the plan, identifying quantitative source reduction and recycling goals, performing Pollution Prevention Opportunity Assessments, and incorporating pollution prevention designs and training into new facilities or processes.

Another aspect of the SNL/NM environmental management strategy includes the implementation of a comprehensive recycling program to reduce the amount of waste generated onsite. Annual projections for recycled waste are presented in Figures 5.3.10–1, 5.3.10–2, and 5.3.10–3. Actual waste trends are shown for RCRA hazardous, TSCA PCB, and TSCA asbestos wastes in Figures 5.3.10–4, 5.3.10–5, and 5.3.10–6. SNL/NM has identified an overall goal to reduce the generation of radioactive and hazardous wastes onsite by 50 percent from the 1993 level, and to reduce the annual generation of sanitary waste by 33 percent.

5.6.12 Noise and Vibration

No impacts would be anticipated; therefore, no specific mitigation measures would be required. However, the existing Weather Watch Program is used by KAFB meteorologists to help engineers select a time for testing when atmospheric conditions are most favorable for deadening sound. These conditions exist during cloudless days with unstable air as opposed to meteorological conditions that favor noise propagation such as when it is overcast or there is an inversion (DOE 1997e).

5.6.13 Socioeconomics

No mitigation measures would be required.

5.6.14 Environmental Justice

In general, no mitigation measures would be required. If access to traditional cultural sites becomes an issue, the DOE would consult with the respective Native American tribe to develop an agreement and procedure for access to specific sites. Any agreement would have to take into account the additional security enforced by that particular SNL/NM facility.

5.7 UNAVOIDABLE ADVERSE EFFECTS

Under any of the three alternatives, SNL/NM operations would require the use of large quantities of groundwater, approximately 400 to 500 M gal per year. Analysis shows that the regional demands on the Albuquerque-Belen Basin aquifer would continue to exceed recharge. SNL/NM's portion of water use in Albuquerque would be less than 2 percent (400 M gal per year, compared to 35 B gal per year). Although SNL/NM could use waste avoidance measures and has committed to a 30-percent reduction by 2004, water use would be unavoidable.

Other areas where effects would be small but unavoidable include human health, worker safety, transportation, and waste generation.

During normal operations at SNL/NM, a minimal amount of radioactive material and activation products would be released to the environment. However, any radiation dose received by a member of the public from emissions from SNL/NM would be too small to distinguish from naturally occurring background radiation. During normal operations, even with a strong as-low-as-reasonably-achievable (ALARA) program and engineering and administrative controls, some radiological exposures to workers would be expected.

In addition, because hazardous and toxic chemicals would be routinely handled at SNL/NM facilities, worker exposure to these chemicals would be unavoidable. However, no onsite chemical concentrations would exceed the Occupational Exposure Limit (OEL) guidelines. Analysis has shown that chemical pollutant emissions would be of minimal consequence and would not pose a danger to the public. For details on the human health and worker safety impacts, see Sections 5.3.8.1, 5.4.8.1, and 5.5.8.1, and Appendix E.

Under any alternative, many different materials and waste streams would be transported at SNL/NM, and such transport would have unavoidable adverse consequences. Transporting materials along public routes would impose unavoidable effects on the environment, which include health effects from radioactive materials and truck emissions.

SNL/NM operations would generate a variety of wastes (including radioactive, biohazardous, solid, liquid, gas, and sanitary) as an unavoidable result of normal operations. Although SNL/NM uses pollution prevention and waste avoidance measures, generation of chemical and radioactive wastes would be unavoidable. SNL/NM would continue to further reduce hazards and potential exposures through the continued success of pollution prevention and waste avoidance measures. Details regarding waste generation impacts are presented in Sections 5.3.10, 5.4.10, and 5.5.10 for each alternative. Appendix H contains expanded information on SNL/NM operations regarding waste generation.

5.8 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The implementation of any of the alternatives would cause some adverse impacts to the environment and permanently commit some resources to specific SNL/NM activities. The alternatives for SNL/NM would require the short-term use of resources (for example, fuel, electricity, water, material, land, expertise, and labor) to reach the long-term goal of achieving DOE's missions in national security, energy resources, environmental quality, and science and technology.

5.9 IRREVERSIBLE AND IRRETRIEVABLE EFFECTS

Operations at SNL/NM under any of the three alternatives would require an irreversible and irretrievable commitment of resources. A commitment of resources is irreversible when its primary or secondary impacts limit the future options for a resource. For example, as a landfill receives waste, the primary impact is a limit on waste capacity. The secondary impact is a limit on future land use options. An irretrievable commitment refers to the use or consumption of a resource that is neither renewable nor recoverable for use by future generations. This section discusses four major resources–water, land, material, and energy–that are committed irreversibly or irretrievably under the three alternatives.

5.9.1 Water

All SNL/NM water needs are met by groundwater. Regional demand on the Albuquerque-Belen Basin aquifer continues to exceed recharge. Therefore, large portions of the water resources that support SNL/NM operations represent expenditure of a nonrenewable resource. The maximum consumption of water under the three alternatives would be 463 M gal per year (No Action Alternative, Section 5.3.2), 495 M gal per year (Expanded Operations Alternative, Section 5.4.2), and 416 M gal per year (Reduced Operations Alternative, Section 5.5.2). Under the Expanded Operations Alternative, MESA would be expected to consume an additional 3.8 M gal per year.

5.9.2 Land

SNL/NM has in the past used onsite landfills for chemical and radioactive waste disposal of SNL/NM-generated wastes. These sites and other ER Project sites are essentially unavailable for use for other purposes due to a variety of factors. These include construction-related criteria involving soil compacting, regulatory restrictions, and compatibility issues related to DOE missions. The total acreage removed from future or unrestricted use is yet-to-be-determined, because some sites (for example, the CWL) would require continued monitoring, limited access, limited use, and potentially require other future corrective actions for an extended period of time.

5.9.3 Material

Resources irreversibly and irretrievably committed during the 10-year period of the SWEIS, associated with the operation of SNL/NM in support of DOE missions and programs include construction, maintenance, and operational support materials. Consumption of these widely available materials would not be expected to result in critical shortages. Appendix A contains information related to the types and quantities of materials used, stored, and shipped to support SNL/NM operations.

5.9.4 Energy

The irretrievable commitment of resources during construction and operation of the facilities would include nonrenewable fuels to generate heat and power. Energy would be expended in the form of electricity and natural gas. The maximum consumption of electricity, 198,000 MWh per year, would occur under the Expanded Operations Alternative. Corresponding natural gas consumption would be at 475 M ft^3 per year (see Section 5.4.2). Under the Expanded Operations Alternative, MESA would be expected to contribute an additional 6,000 MWh and 6 M ft^3 of natural gas consumption annually.

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